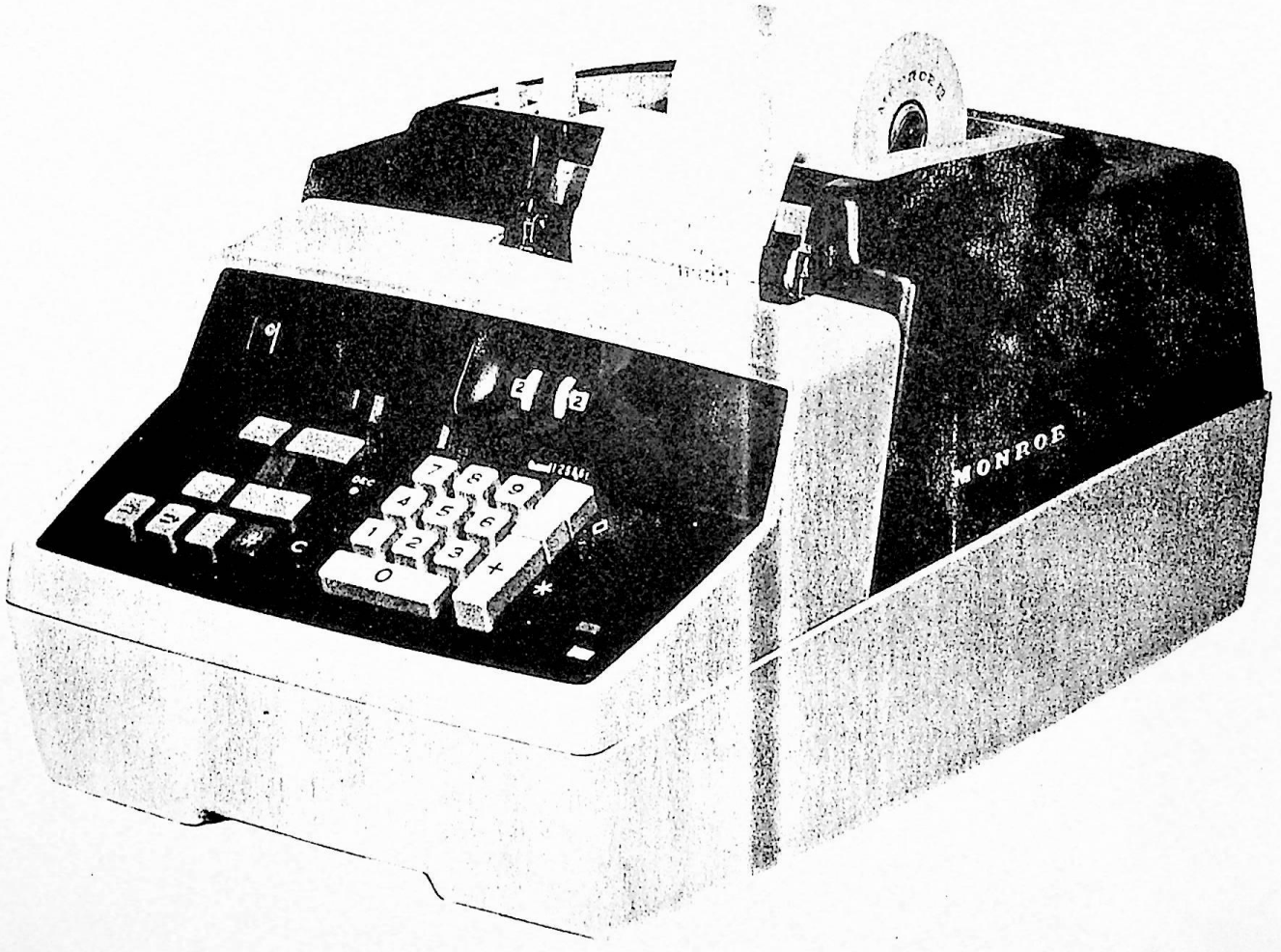
CALCULATOR SERVICE BULLETIN #P2-502

MODEL 211PC192

SERVICE TRAINING MANUAL



MONROE

A DIVISION OF LITTON INDUSTRIES

MONROE INTERNATIONAL, INC.

GENERAL SERVICE DEPARTMENT, ORANGE, NEW JERSEY

CALCULATOR SERVICE BULLETIN #P2-502

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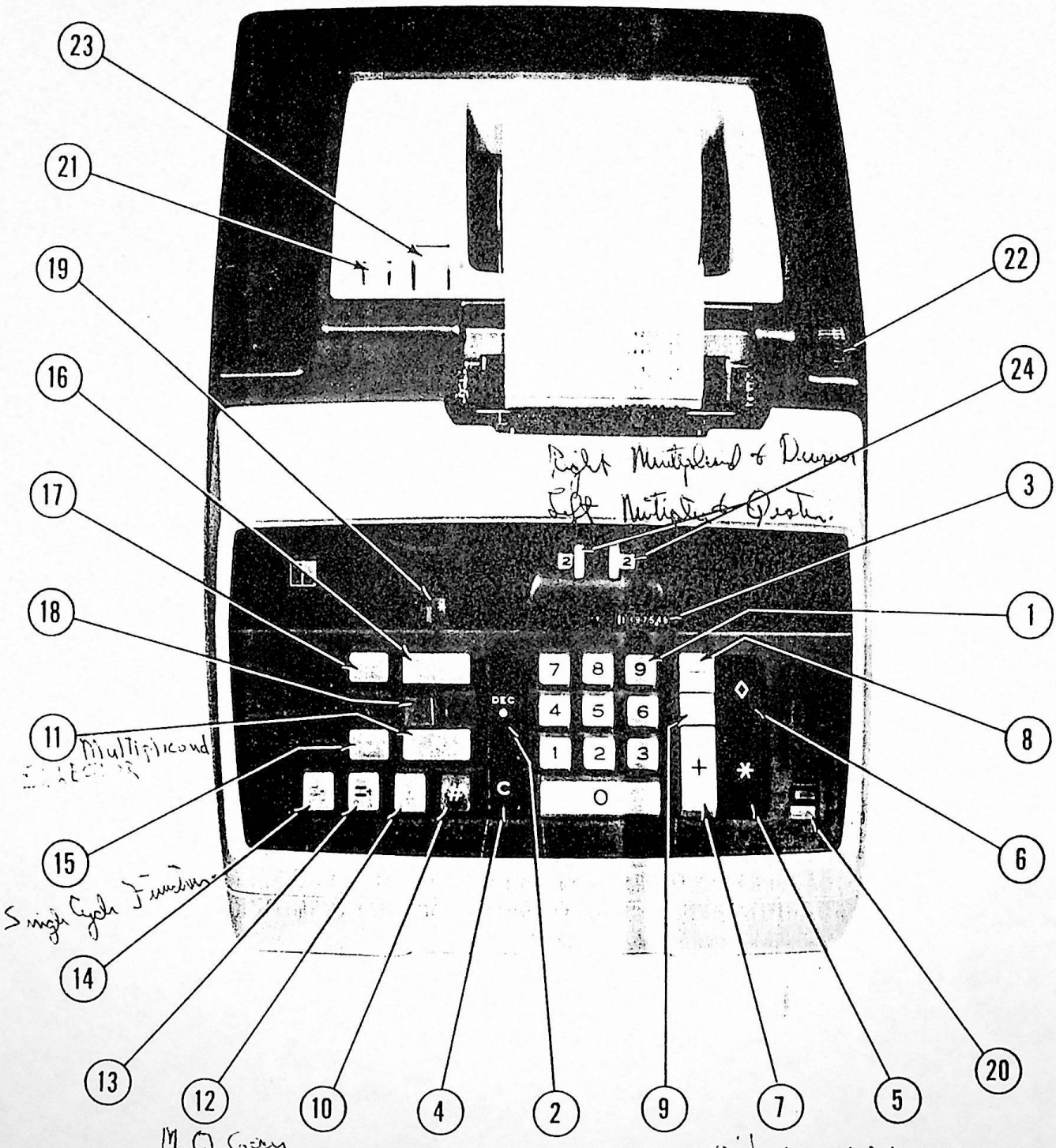
SECTION I

INTRODUCTORY INFORMATION

Operating Keys and Controls



Description of Operating Keys and Controls

1. NUMERAL KEYBOARD This keyboard, with the touch of an electric typewriter, is an "open" keyboard. The operator sets amounts up to twelve digits even while the calculator is multiplying or dividing. Interlocks prevent depression of more than one key at a time.

2. DECIMAL BAR DEC• The decimal bar places the decimal point in the amount set in the keyboard. For example, 1.25 is set as 1, DEC• ,25.

3. SET-UP CARRIAGE DIALS These dials display the amount that is set in the keyboard. The decimal point is also displayed.

4. KEYBOARD CLEAR KEY C Depress the C key to clear the amount set in the keyboard. A lock prevents depression while the calculator is multiplying or dividing.

5. TOTAL KEY * Depress the * key to print and clear the adding machine total. It can be depressed while an amount is set in the keyboard.

6. SUB-TOTAL KEY ◊ Depress the ◊ key to print the adding machine total. The total does not clear. This key can be depressed while an amount is set in the keyboard.

7. PLUS BAR + The + bar prints and adds the amount set in the keyboard.

8. MINUS BAR - The - bar prints and subtracts the amount set in the keyboard.

9. REPEAT KEY For repeat addition or subtraction hold down the repeat key at the same time as the plus bar or minus bar.

10. NON-ADD KEY # Depress the # key to print the amount set in the keyboard.

11. ENTER MULTIPLICAND KEY × Depress the × key to set up the amount in the keyboard as a multiplicand. The amount prints, identified by an ×, and the keyboard clears. A multiplicand stays in the machine until it is cleared by setting up another amount. Depressing the × key and the transfer key sets up the adding machine total as a multiplicand. This transfer does not disturb an amount set in the keyboard.

12. MULTIPLICATION KEY = Depress the = key to multiply and print the product. The calculator counts by the amount set in the keyboard and the keyboard clears automatically.

13. ACCUMULATIVE MULTIPLICATION KEY =+ Depress the =+ key to multiply, print and add the product to the adding machine total.

14. NEGATIVE MULTIPLICATION KEY =- Depress the =- key to multiply, print the product in red and subtract it from the adding machine total.

15.SQUARING KEY □ Depress the □ key and × key together to enter the multiplicand and hold it in the keyboard for squaring. Depress a multiply key to complete the squaring operation. Depress the □ key with any of the multiply keys to retain the amount in the keyboard for further use.

16.DIVIDEND ENTRY KEY ÷ Depress the ÷ key to enter as a dividend the amount in the keyboard. Depress this key and the transfer key at the same time to set up the adding machine total as a dividend. This transfer does not disturb an amount set in the keyboard.

17.DIVISION KEY ÷ Depress the ÷ key to print the divisor and start division. Division alignment is automatic. Both the quotient and the remainder are printed automatically.

18.TRANSFER KEY The transfer key is used with the ÷ key and the × key to set up the adding machine total as either a dividend, multiplicand, or divisor.

19.TRANSFER CONTROL ◊/* In the * position, the adding machine clears whenever a transfer is made. In the ◊ position, the total transfers and stays in the adding machine. The normal position is * .

20.CONSTANT/TRANSFER CONTROL ÷×/*× The ÷× position makes any divisor or multiplicand both a constant divisor and a constant multiplicand. The constant multiplicand prints only when it is set up by the × key. The constant divisor prints when it is first set up by the ÷ key; thereafter it prints ÷× without the amount. The *× position programs the calculator to set up a quotient as a multiplicand.

21.LINE SPACE CONTROL In the forward position, towards the operator, the tape will space up once on the depression of a control and will double space for totals. In the rear position, the tape will double space for all items.

22.PLATEN KNOB Used to advance or move back the printed tape.

23. Platen Release Lever has three positions. The forward position is the normal position. Pushing the lever all the way rearward releases the platen rollers to permit adjusting the paper. In the halfway position, the platen tear-off moves away from the platen to facilitate changing the paper roll.

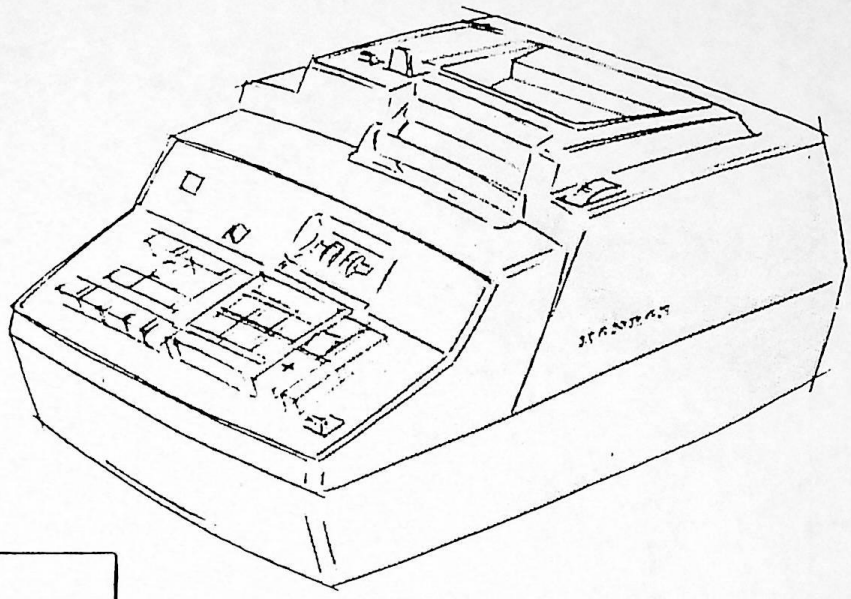
24.DECIMAL CONTROL KNOBS The decimal control knobs set the automatic decimal points. The left knob for multiplier and quotient. The right knob for multiplicand and divisor. The total of both knobs determines the decimal position for addition, subtraction, dividends, products, totals and sub-totals.

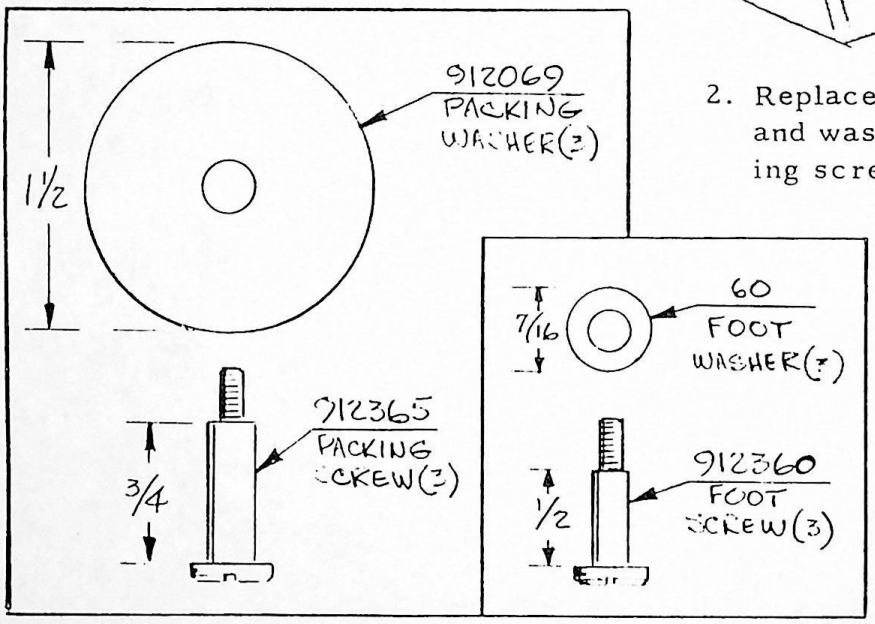
FUNCTION-SYMBOL CHART

VARIABLE FACTORS
(listed only when they effect symbol)

FUNCTION	Acc. Condition	Transfer Control	Const/Quot Tr. Control	SYMBOL	
Minus				−	
Total	Pos.			✳	
Total	Neg.			✳̲	
Sub-Total	Pos.			◊	
Sub-Total	Neg.			◊̲	
Non-Add					#
Multiplicand					×
Tr. Multiplicand	Pos.	Total		✳	×
Tr. Multiplicand	Neg.	Total		✳̲	×
Tr. Multiplicand	Pos.	Sub-Total		◊	×
Tr. Multiplicand	Neg.	Sub-Total		◊̲	×
Dividend					÷
Tr. Dividend	Pos.	Total		✳	÷
Tr. Dividend	Neg.	Total		✳̲	÷
Tr. Dividend	Pos.	Sub-Total		◊	÷
Tr. Dividend	Neg.	Sub-Total		◊̲	÷
Multiply				=	
product				✳	
Accum. Multiply	Pos.			=	+
product				✳	
Neg. Multiply	Neg			=	−
product				✳̲	
Divide			Const. Divisor	≒	×
quotient				✳	
remainder					R
Divide			Quotient Tr.	≒	
quotient				✳	×
remainder					R

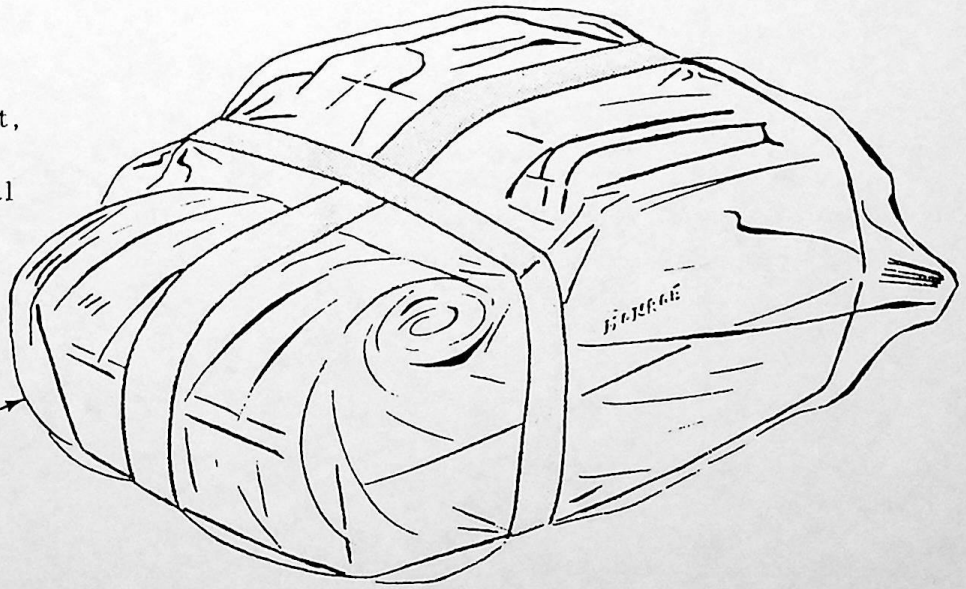
1. With machine neutralized, and motor cord removed, depress plus key.

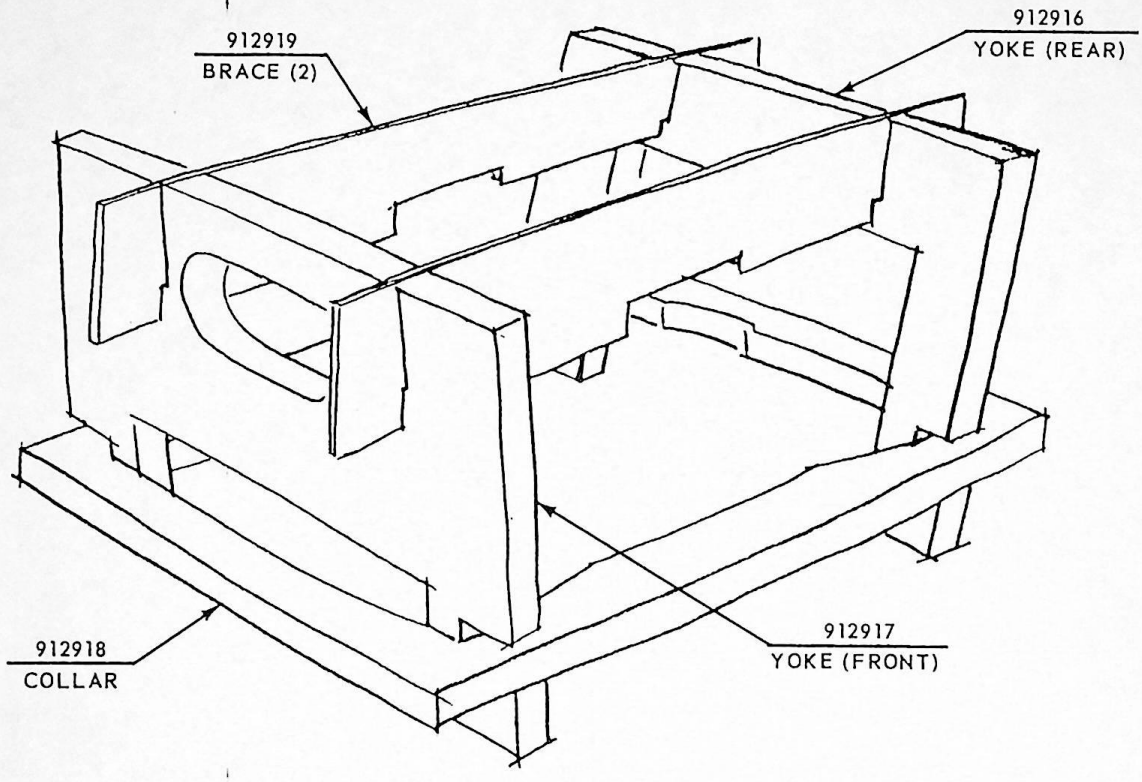




2. Replace the regular foot screws and washers with the larger packing screws and packing washers.

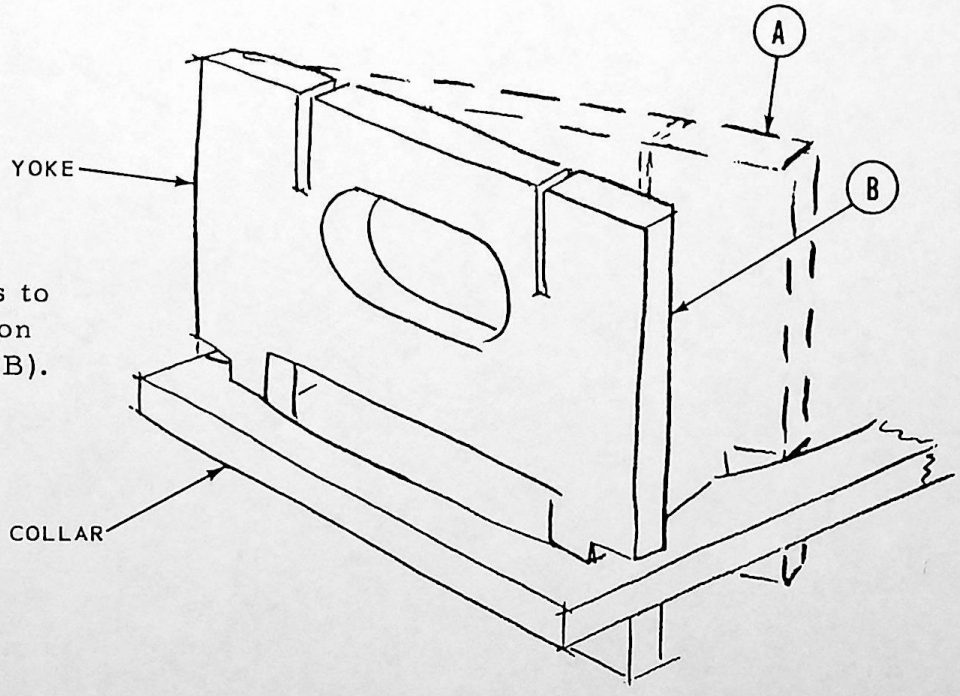
3. Place machine, rear first, in plastic bag. Roll and bunch excess bag material over keyboard area and tape securely as shown.





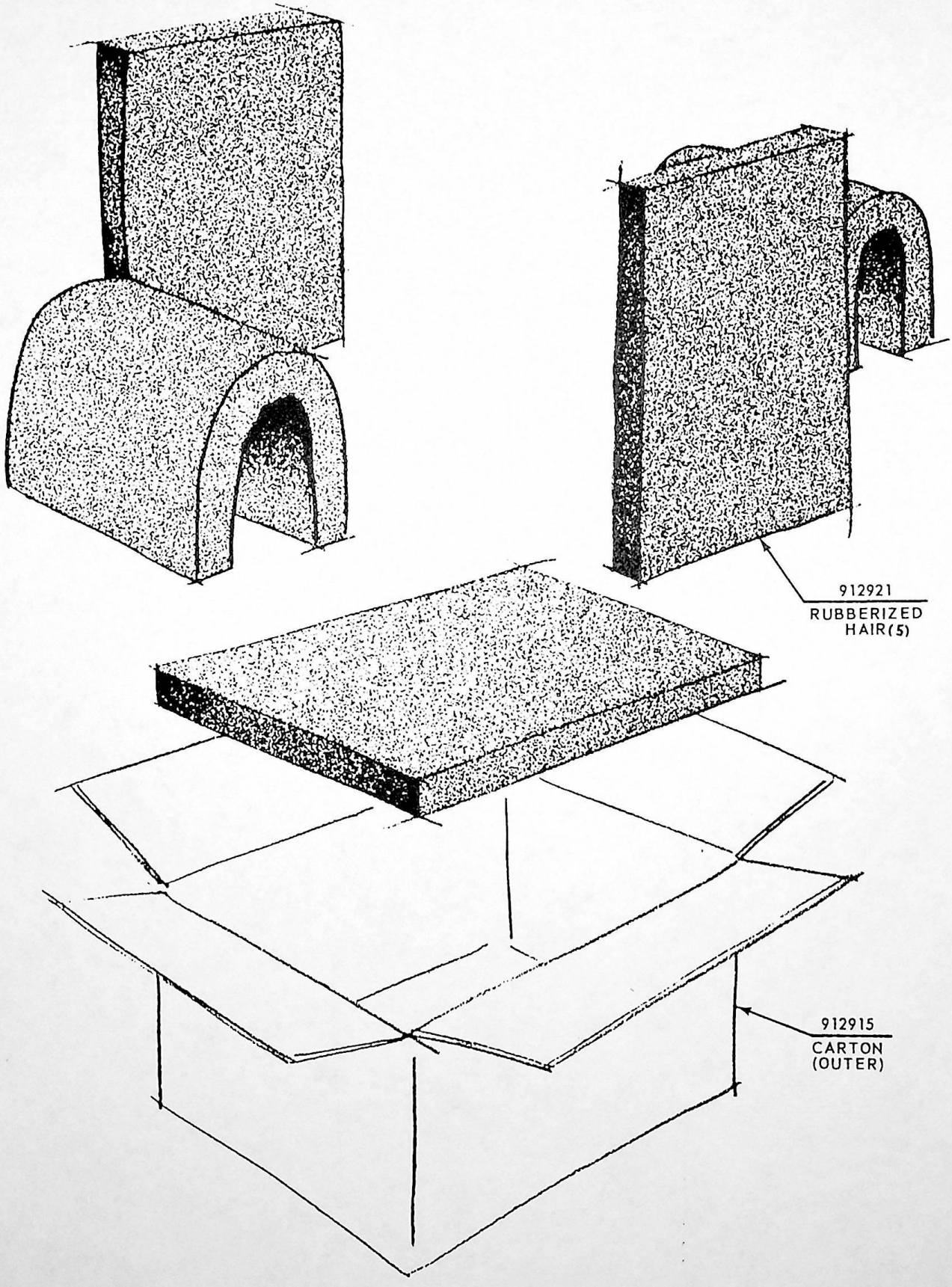
Part numbers and assembly detail of packing frame components

4. Assemble front and rear yokes to collar and place wrapped machine, keyboard end first, into this assembly.

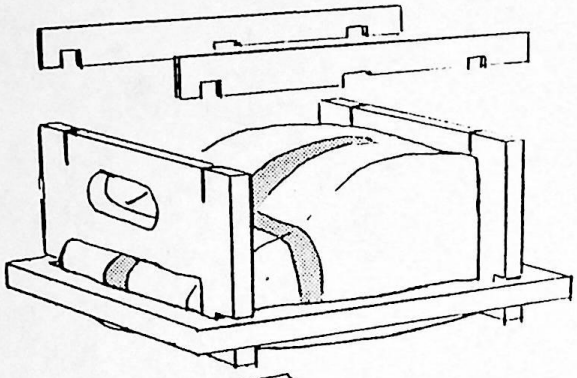


To assemble packing yokes to collar, place yoke in position (A) and push into position (B).

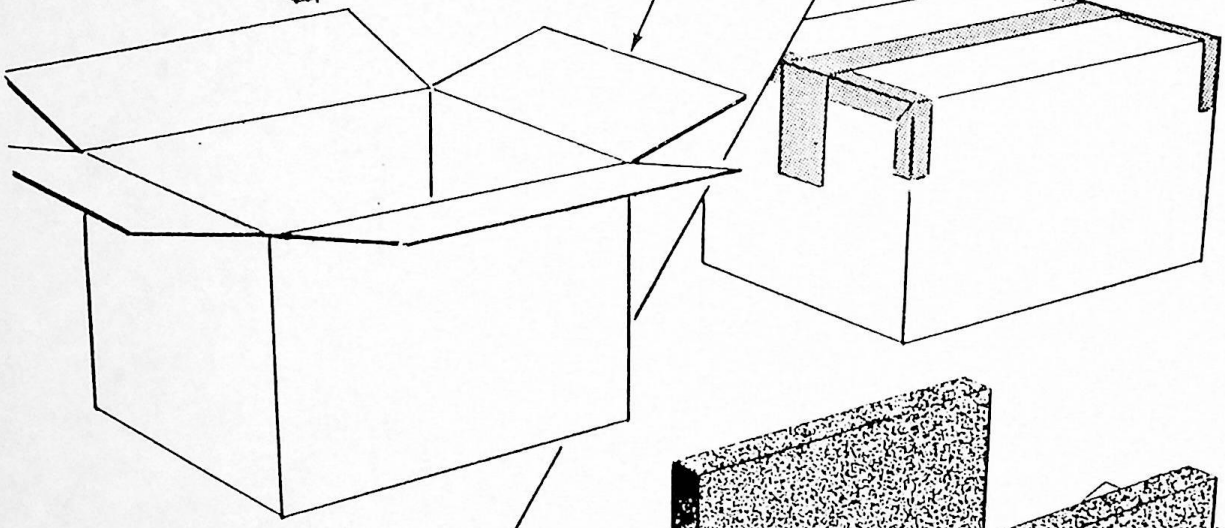
5. Assemble outer carton and hair packing material.

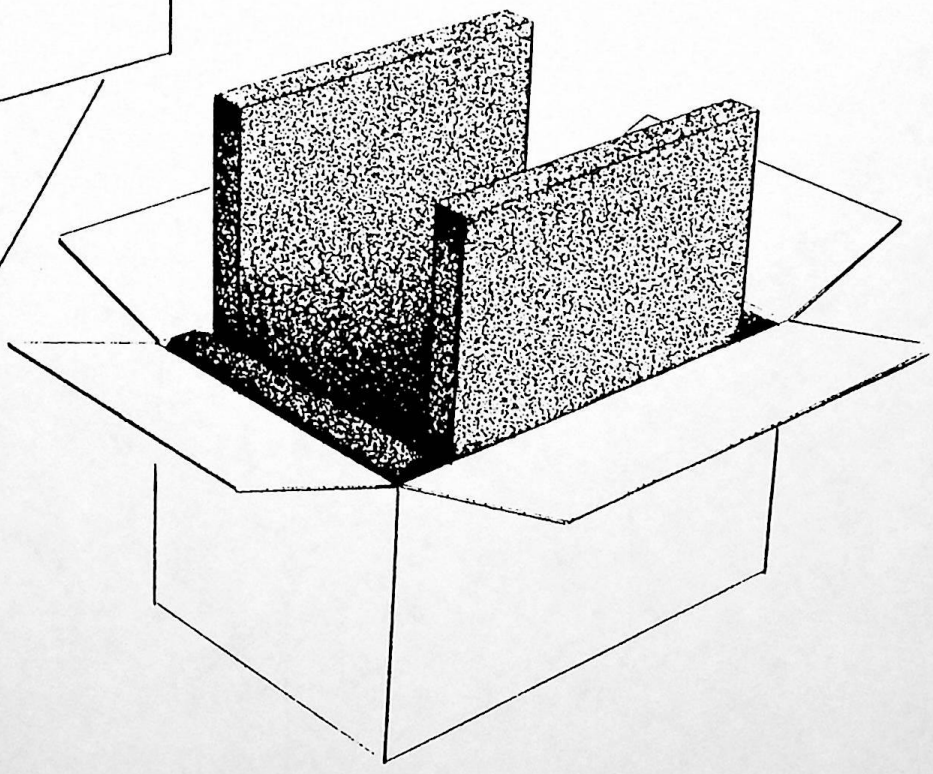


ACCESSORIES	
(1) 3 7/16" PAPER ROLL	(1) L 59903a RIBBON SPOOL
(1) 69792 MOTOR CORD	(3) 912360 FOOT SCREWS
(1) CC-9 DUST COVER	(3) 60 FOOT WASHERS
(1) #16 RIBBON	(1) 912923 POLY-FILM BAG



912914
CARTON
(INNER)



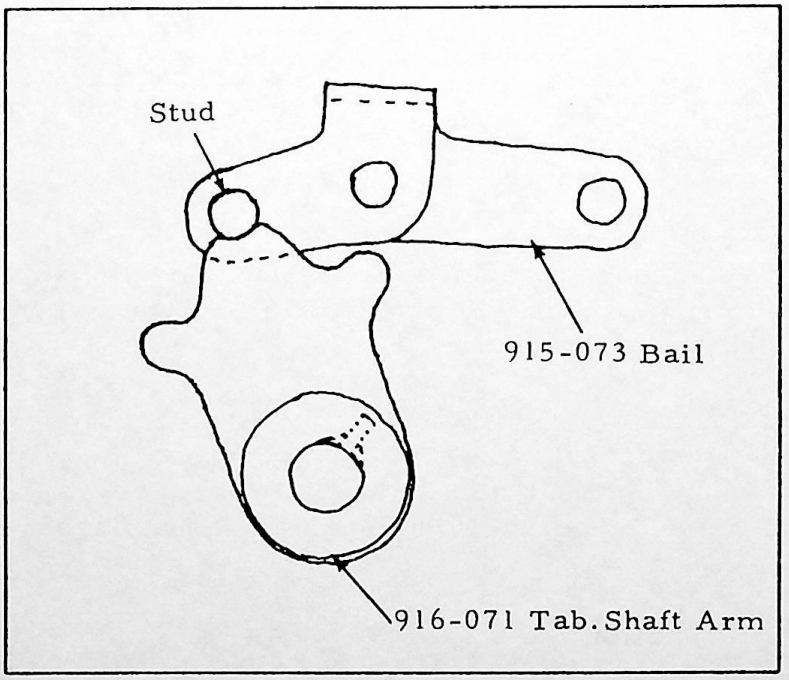


6. Place machine assembly in inner carton with accessories and seal securely with gummed tape.

7. Place inner carton in outer carton with packing material and secure top closed.

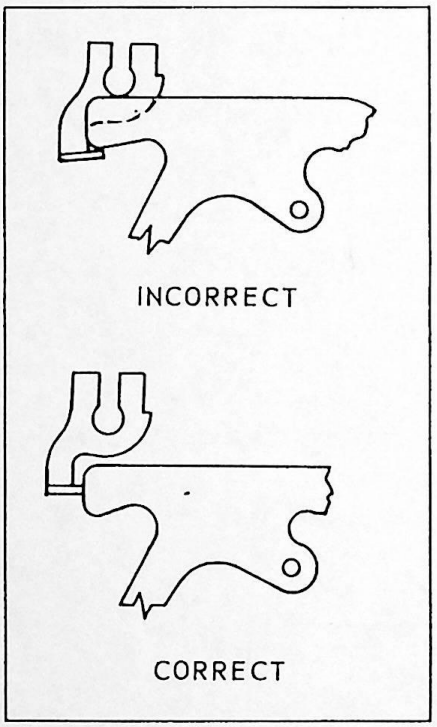
UNPACKING

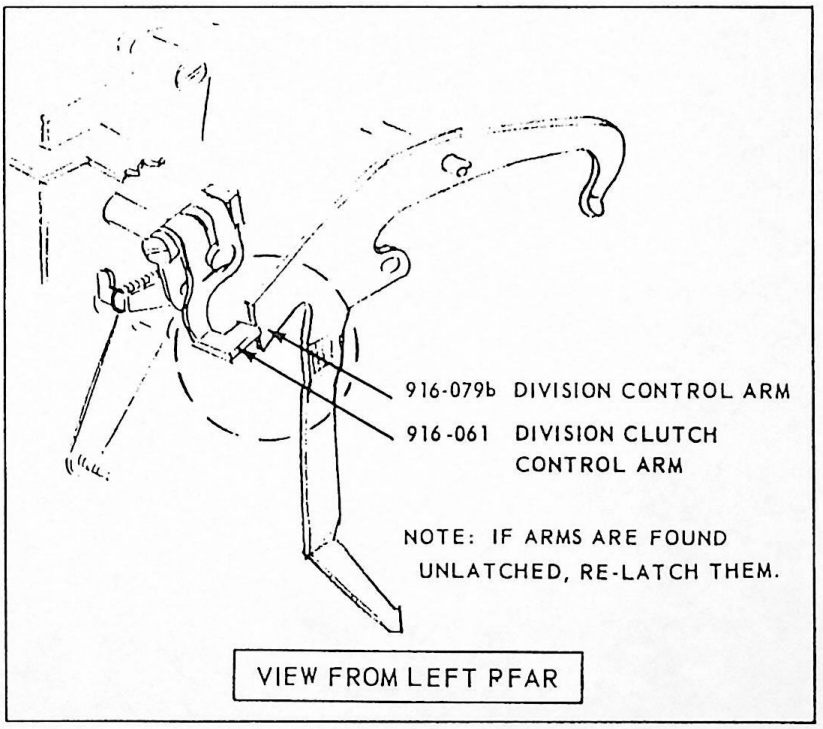
1. Remove all staples from top of outer carton and open carton.
2. Cut thru paper tape along seam in top of inner carton and open inner carton.
3. Lift out the two narrow cardboard braces that connect the thick cardboard packing yokes.
4. Remove the plastic bag containing the dust cover, paper roll, etc.
5. Place carton on a large table and lay it over on either of its long sides.
6. Grasp front and rear packing yokes and slide machine and packing assembly out of inner carton.
7. Remove packing collar and yokes and plastic bag from machine.
8. Place machine on its back and, one at a time, replace packing screws and washers with the regular foot screws and washers supplied.
9. Check that 916-071 tabulator shaft arm is not tripped.... The stud of 915-073 bail should be located in center notch of 916-071 arm. If arm is tripped in either direction, return it to center position.



Unpacking (Cont'd.)

10. Remove keyboard cowl and rear cover * and check that 916-061 div. clutch control arm is latched on 916-079b div. control arm as shown.



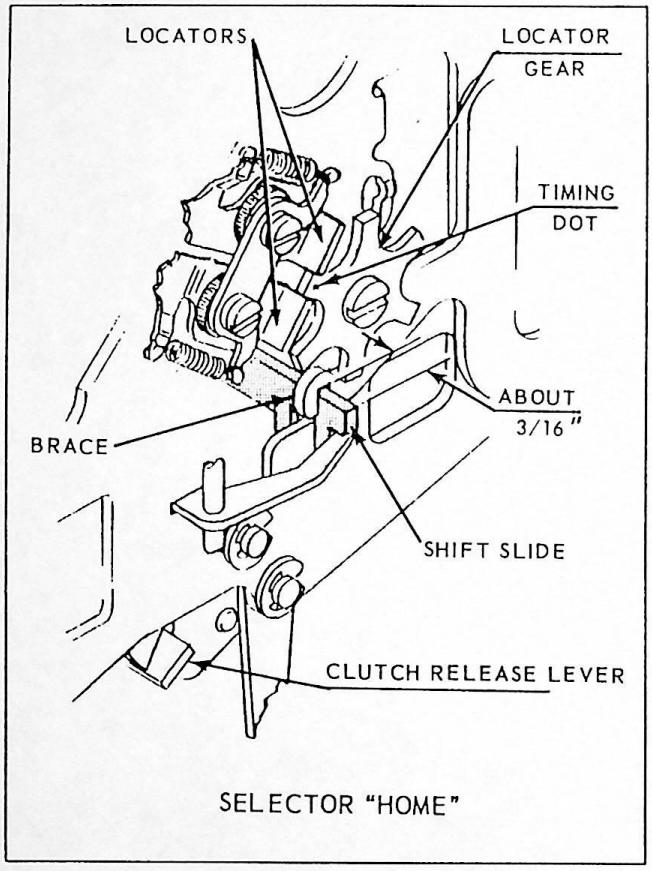

916-079b DIVISION CONTROL ARM
916-061 DIVISION CLUTCH CONTROL ARM
NOTE: IF ARMS ARE FOUND UNLATCHED, RE-LATCH THEM.
VIEW FROM LEFT REAR

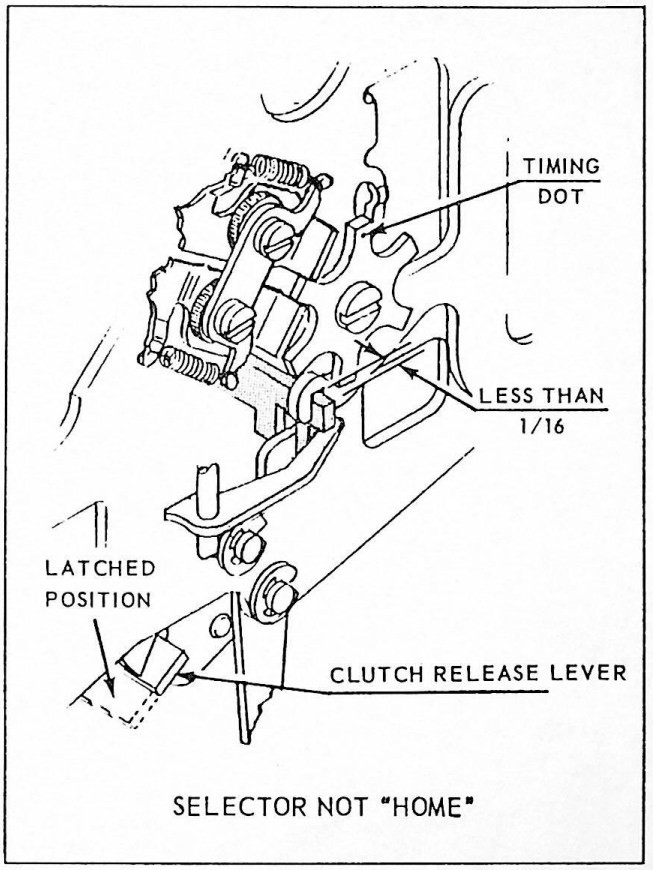
11. Install paper roll, ribbon and motor cord. (Machine will cycle plus since this mechanism was tripped as part of the packing procedure.) NOTE: See Page IV-D-20 for ribbon installation.

*CAUTION: With keyboard cowl and rear cover removed, never turn machine upside down while holding only the bottom cover. If it is necessary to turn machine upside down, support it with heel of hand on print unit and fingers over platen.

Unpacking (Cont'd.)

12. If it was necessary to re-latch the division clutch control arm (916-061), check to see if the selector is in "home" position. (It may have shifted left one column on plus cycle when motor cord was plugged in.)





If the selector is in 'home' position, the timing dot on the locator gear will be positioned between the two locators and the end of the shift slide will be projecting out about 3/16" from its brace.

If the selector had shifted left one column, then the timing dot on the locator gear would be positioned one tooth clockwise from the locators, and the end of the shift slide would project less than 1/16" from its brace.

If the selector is found to be shifted left, then move the clutch starting arm down to its latched position and depress the clear key. This will restore the selector to home position.

13. Check machine speed.

14. Proceed with inspection and operating test.

Test time is approximately 45 minutes.

Decimal dials should be set at 0 and 0 unless otherwise stated.

Symbolization Check

Depress: Sub-total key; total key; clear key; multiplication key; accumulative multiplication key; negative multiplication key; transfer key with both the enter multiplication key and the enter dividend key; set a zero and depress enter multiplication key.

Division Runout Check

A. Set a 1 and then depress the divide key.
B. Several zeros and then the divide key.

Non-add Check

Set 12 1's and depress the non-add key.

Repeat this check with 2's, 3's, 4's through 9's. Depress total key.

A. Set twelve 1's and depress plus bar.
Set twelve 2's and depress plus bar.
Continue to add 3's, 4's, through 9's.
Depress sub-total key.
Depress total key.
Result 4999999999995

B. Set twelve 1's.
Depress repeat key and plus bar 5 cycles.
Depress repeat key and minus bar 4 cycles.
Depress sub-total key.
Depress total key.
Depress keyboard clear key.

Repeat this test using 2's, 3's, 4's through 9's.

C. Set twelve 1's.
Depress repeat key and minus bar 4 cycles.
Depress repeat key and plus bar 3 cycles.
Depress sub-total key.
Depress total key.
Depress keyboard clear key.

Repeat this test using 2's, 3's, 4's through 9's.

D. 1×9191919191

Using the 1 as a constant multiplicand, perform this multiplication 10 times.

E. 1111111101 ÷ 9 = 123456789
2222222202 ÷ 18 = 123456789
3333333303 ÷ 27 = 123456789

Continue this test dividing 4's by 36, 5's by 45, 6's by 54, 7's by 63, 8's by 72, 9's by 81.

F. Set ten 1's.
Depress square key and multiplication entry key.
Depress square key and accumulative multiplication key.
Depress square key and multiplication entry key again.
Depress square key and negative multiplication key.
Depress square key and multiplication entry key again.
Depress square key and accumulative multiplication key.
Depress transfer key and enter dividend key.
Depress division key.
Result: 1's.

Repeat this test for 2's, 3's, 4's through 9's.

G. $(12)^{10}$ = ~~891610044825~~ 773008370688 (Factor multiplied by itself then the product multiplied by the factor).
Set 12.
Depress square key and multiplication entry key.
Depress square key and accumulative multiplication key.
*Depress transfer key and multiplication entry key.
*Depress square key and accumulative multiplication key.
Repeat the last two steps (*) until answer is obtained.

Depress clear key and total key.

H. $(2.00000)^{24}$ = 16777216.0000000000
Set decimal indicators at ~~5~~ 4 and ~~5.~~ 4.
Set 2.00000
Repeat the steps in Test 8 above, until answer is obtained.

Depress clear key, total key, and restore decimals to 0 and 0.

J. Set total transfer lever at ◊.
Set ten 1's and depress plus bar.
Depress transfer key and multiplication entry key.
Set 1 and depress multiplication key.
Result: 1's.
Depress transfer key and enter dividend key.
Set 1 and depress divide key.
Result: 1's.
Depress total key.

Repeat this test using 2's, 3's, 4's through 9's, multiplying and dividing by 1 each time.

K. Division constant lever at *× for quotient transfer.
Total transfer lever at *.
Set ten 1's and depress enter dividend key.
Set 1 and depress divide key.
Set 1 and depress multiplication key.
Result: 1's.

Repeat this test using 2's, 3's, 4's through 9's, dividing and multiplying by 1 each time.

L. Division constant lever at ÷× for a constant divisor.
Set ten 1's and depress enter dividend key.
Set 123456789 and depress divide key.
Result: 9 with a remainder of 10.

Repeat this test dividing 2's, 3's through 9's by the constant divisor, 123456789. The results will be multiples of 9 and the remainders will be multiples of 10.

Decimal Tests

M. Square 1, 2, 3, 4 through 9 with each square decimal setup, i. e.:

With decimals at 0 and 0 square each number.
With decimals at 1 and 1 square each number.
With decimals at 2 and 2 square each number, etc.

Check each time for the correct printing of the decimal point and number of zeros.

N. With each of the above square decimal setups, divide 1 by 1, 2 by 2, 3 by 3, etc.

Check each time for the correct printing of the decimal point and number of zeros.

P. Divide 4 by 3 with every possible decimal setup, starting with:

Decimal Setting	Dials		
2 - 2	2 - 3	2 - 4	etc.
3 - 2	3 - 3	3 - 4	
4 - 2	4 - 3	4 - 4	
5-- 2	5 - 3	5 - 5	
etc.	etc.	etc.	

Now that you have seen the machine demonstrated and have had an opportunity to try it yourself, you have a pretty good idea of how it is operated and what it can do . . . so, let's see how it works.

Here is a diagram of the major units which process and store figures.

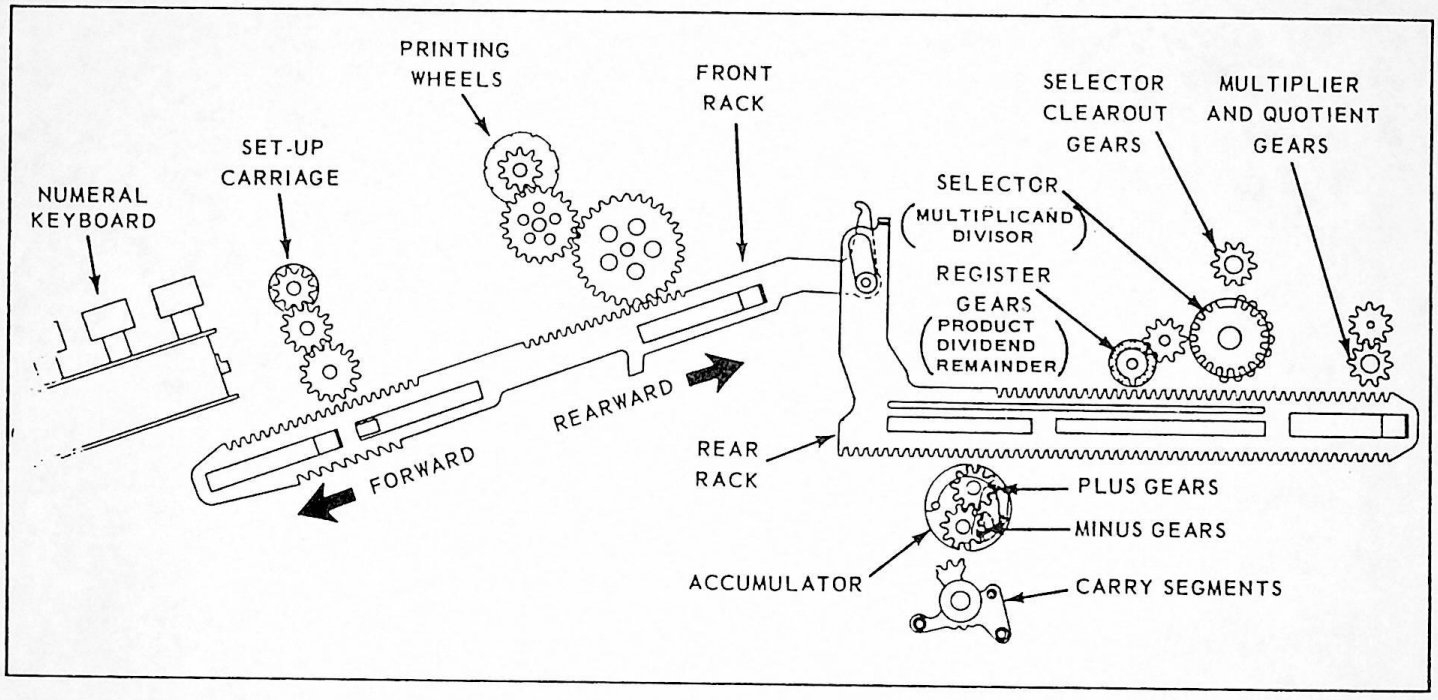


FIGURE PROCESSING UNITS

The Numeral Keyboard enters figures in the set-up carriage.

The racks provide the means for moving an amount from one unit to another.

The Set-up Carriage can be moved down to engage the racks so that an amount entered in it can be moved to some other unit as the racks move rearward. It can then be released from the racks at the end of their rearward movement---or held in engagement with them until they complete their forward (return) movement.

The Printing Wheel Gears are always engaged with the racks; therefore, any amount that is moved from one unit to another is automatically entered in the Printing Wheels on the rearward stroke of the racks and removed on the forward stroke.

The accumulator has two sets of gears: the Plus Gears and the Minus Gears. The neutral position of the Accumulator is centralized between the racks and the Accumulator Carry Segments. It can be moved up into engagement with the racks: during their rearward stroke only (total); during their forward stroke only (plus & minus); or for both the rearward and forward stroke (sub-total). It can be moved down into engagement with the Carry Segments (add & subtract). It can also be pivoted a half turn (180°) so that the Minus Gears are positioned to engage the racks.

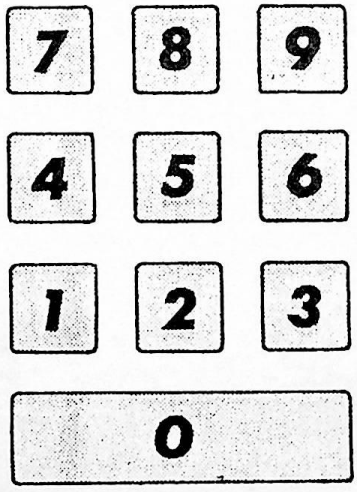
The register can be moved down into engagement with the racks during their rearward stroke (totaling) or during their forward stroke (entering).

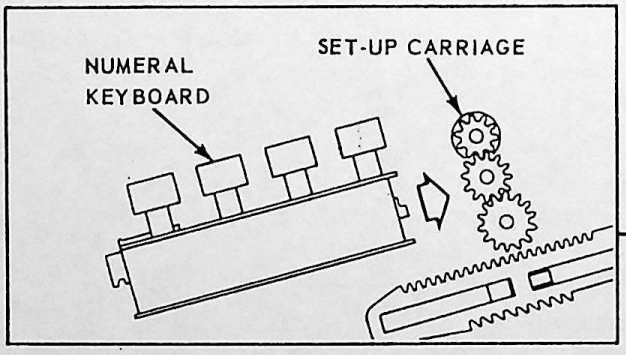
The Selector can be moved up so that its set-up gears engage the Selector Clearout Gears (for clearing), then down so that its set-up gears engage the racks during their forward (return) stroke (for entering).

The Multiplier/Quotient Gears can be moved down into engagement with the racks during their rearward stroke (for a quotient total) or during their forward stroke (for multiplier entry).... but not both on the same cycle.

Before going into detail on any particular mechanism, let's take a look at how these units are affected by the operation of the various keys and controls that have been provided. After all, to produce the movements that will be described here, is the purpose of all that mechanism in the machine. So it is logical that an understanding of the basic functions of the machine should be our first order of business. We will take it key by key from the simpler functions thru the more complicated. No attempt will be made to describe what causes the movements to occur. It will be enough for now, just to know when they happen.

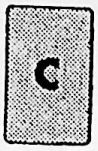
NUMERAL KEYS



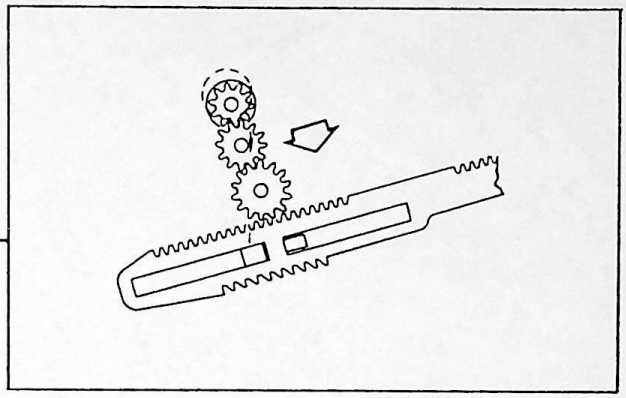


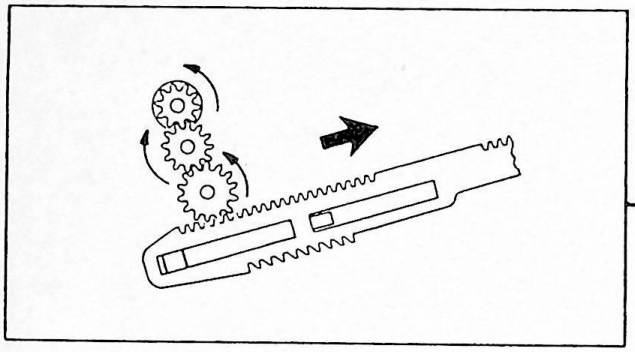
Depression of keys on the numeral keyboard cause the corresponding figures to be entered in the set-up carriage.

CLEAR KEY



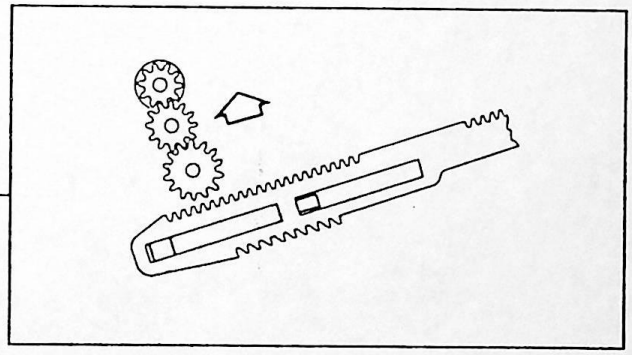
Depression of the clear key causes the set-up carriage to move down into engagement with the front racks.

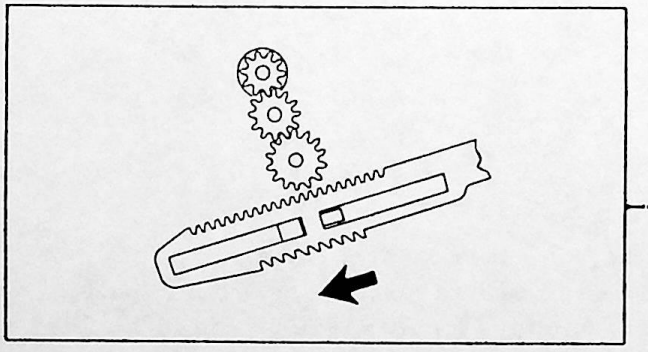




The racks move rearward, removing the figure from the set-up carriage.

The carriage then disengages...





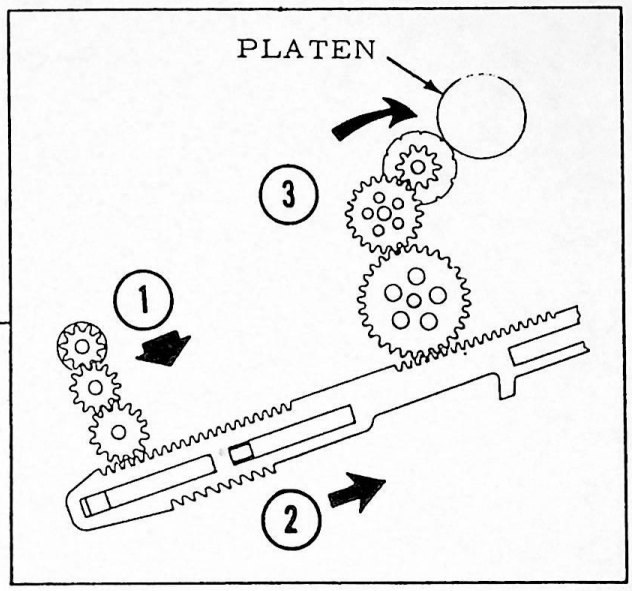
...and the racks move forward to neutral position.

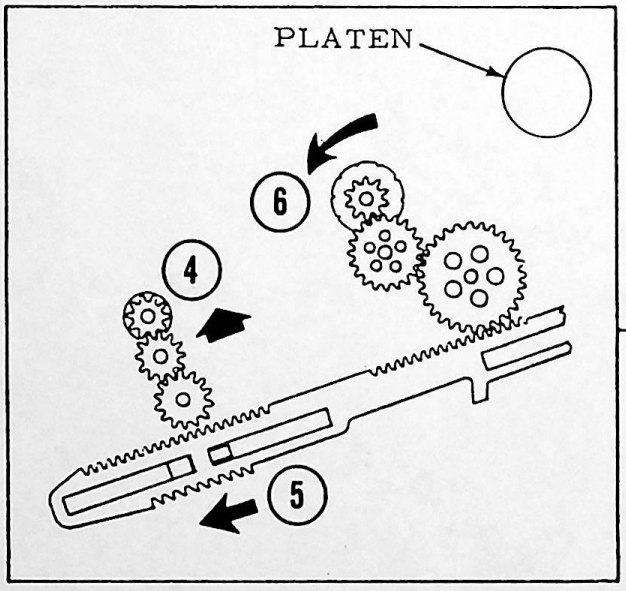
NOTE: While the figure removed from the set-up carriage is turned; first into, then out of the printing wheels, these wheels are not fired. Therefore no print or space-up occur.

NON-ADD KEY

The non-add function starts the same as the clear function: (1) Set-up carriage moves down...(2) racks move rearward...

With the racks at their rearward limit* the printing wheels are fired (3).



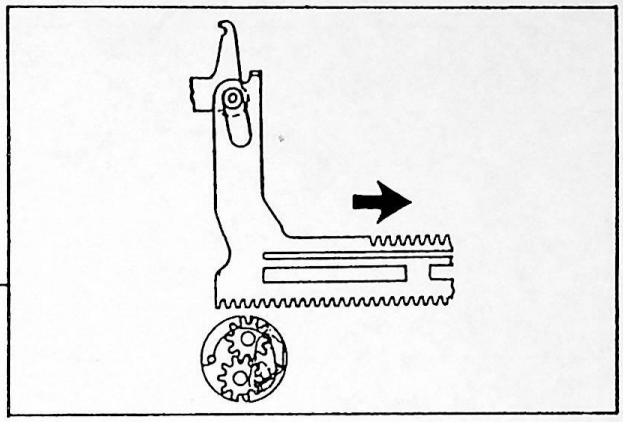


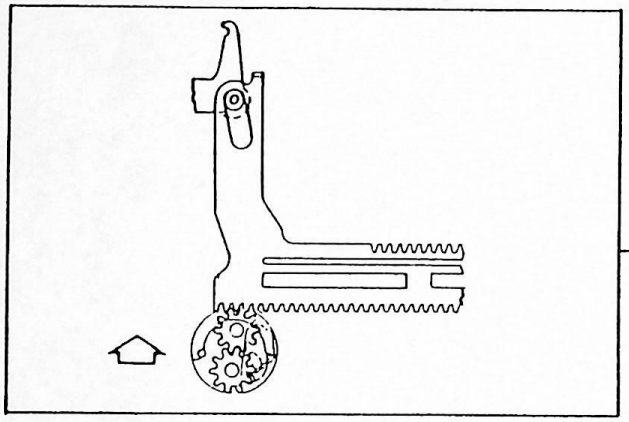
With the figure thus printed, the set-up carriage disengages (4)....The racks are restored to neutral (5)...and the printing wheels are restored to neutral (6). The tape is spaced up as the racks are restored to neutral.

*The rearward limit of each individual rack is, of course, determined by the amount entered in the set-up carriage. For ease of understanding we have illustrated the rack in its fully rearward position whenever reference is made to this rearward limit.

PLUS KEY

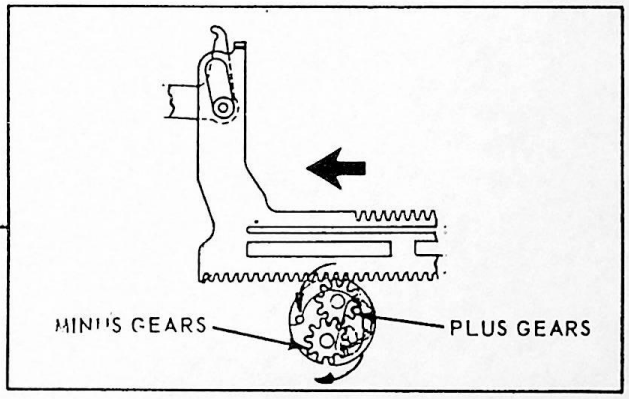
Same as non-add key except: when the racks reach their rearward position....



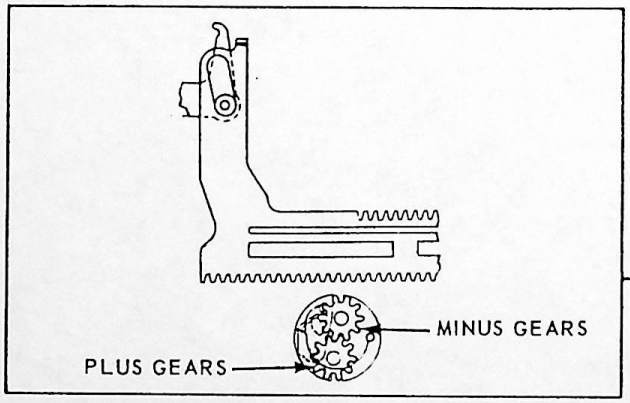


...the accumulator moves up into engagement with the rear racks.

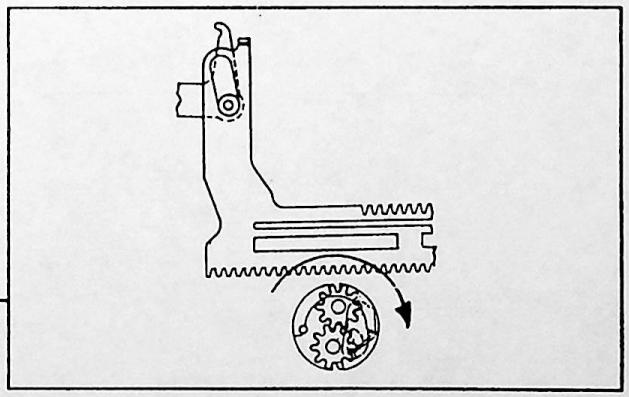
The figure is added to the plus accumulator gears as the racks move forward to neutral.



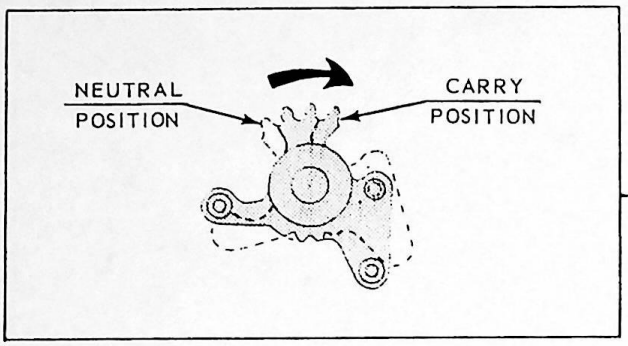
NOTE: if the previous operation had been negative, the accumulator would still have been positioned so that it's minus gears were in the rack engaging position...



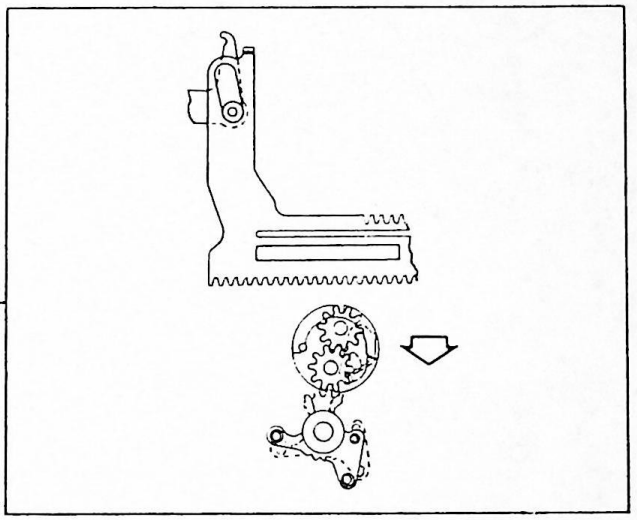
In this event, the accumulator would first be pivoted clockwise 180° to put the plus gears in the rack engaging position. This would occur before the racks moved to the rear (as shown in top picture).



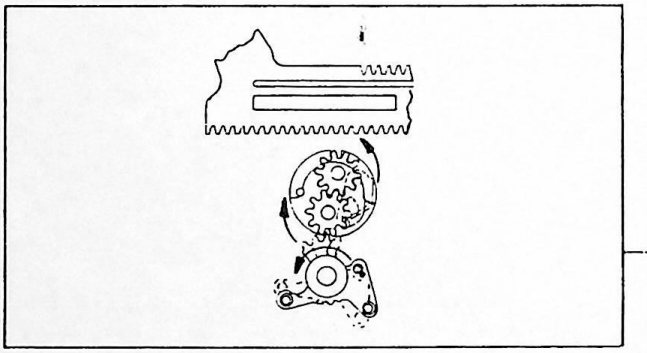
PLUS KEY (cont'd.)



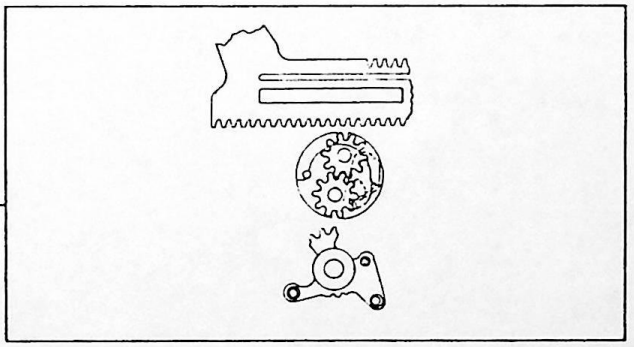
If any carry-overs were called for during the forward movement of the racks, the appropriate carry sectors are now displaced to their carry position.
NOTE: This mechanism will be described in detail under "PLUS KEY"



The accumulator moves down, out of engagement with the racks, and into engagement with the carry sectors....

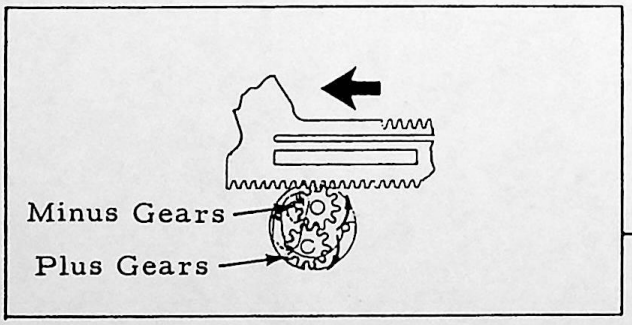


...any sectors that had been displaced are restored to neutral...adding the carry-over to the appropriate gears.



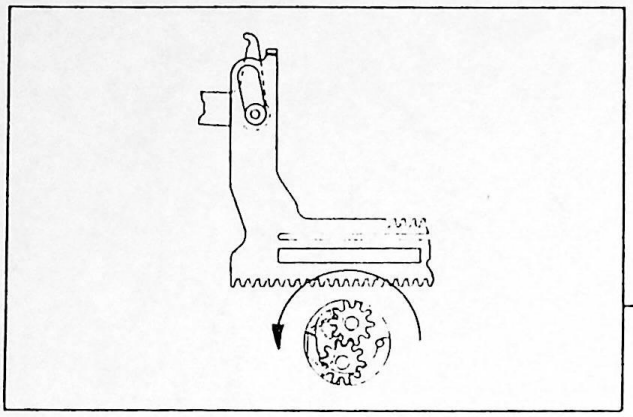
The accumulator now moves up to its neutral position.

MINUS KEY



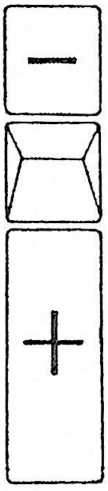
Same as plus key except: instead of adding to the plus accumulator gears, the figure is added to the minus accumulator gears. The figure prints in red.

MINUS KEY (cont'd.)

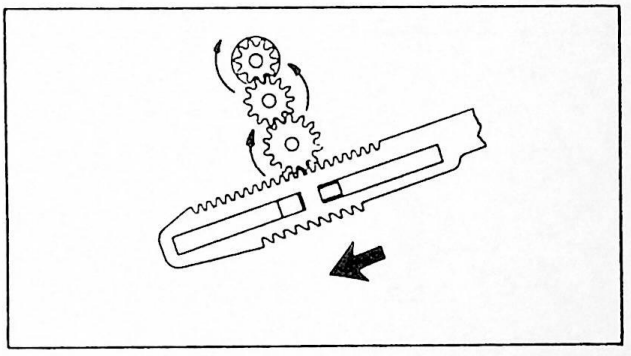


Also, the reverse of the note made under "plus key" would occur... that is, if the previous operation had been positive, the accumulator would first be pivoted 180° counterclockwise, to put the minus gears in rack engaging position.

REPEAT KEY

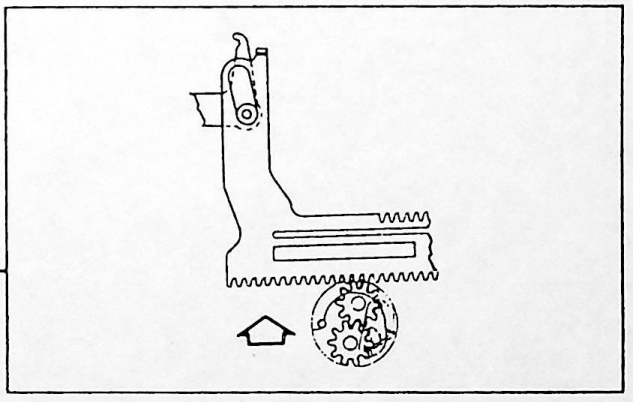


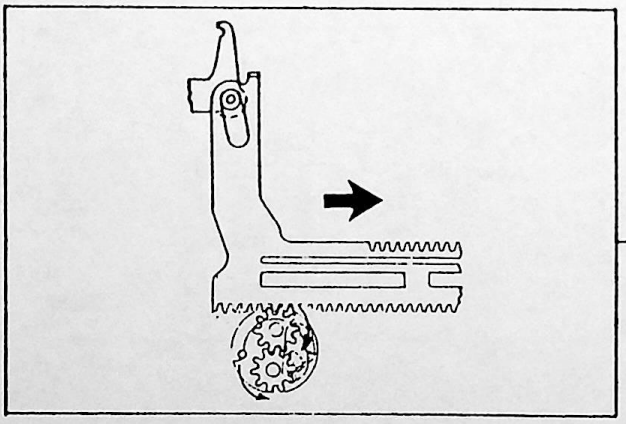
This key is used with either the plus key or minus key. Its function is to keep the set-up carriage engaged with the racks until they move forward to neutral so that the figure is re-entered in the set-up carriage. It also disables the set-up carriage return and single cycle mechanism.



TOTAL KEY

Depression of this key causes the accumulator to move up into engagement with the rear racks. (after being positioned + or -).

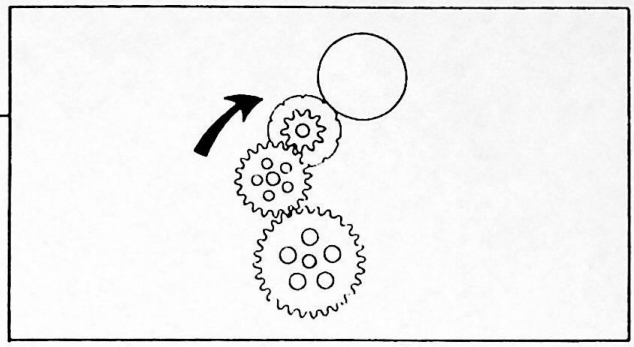


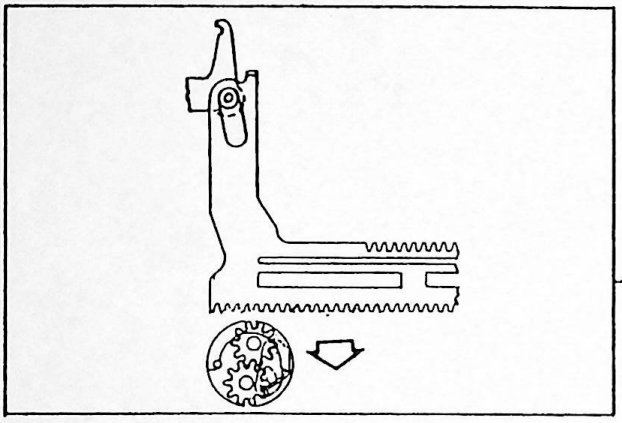


The racks then move rearward, and remove the figure from the accumulator.

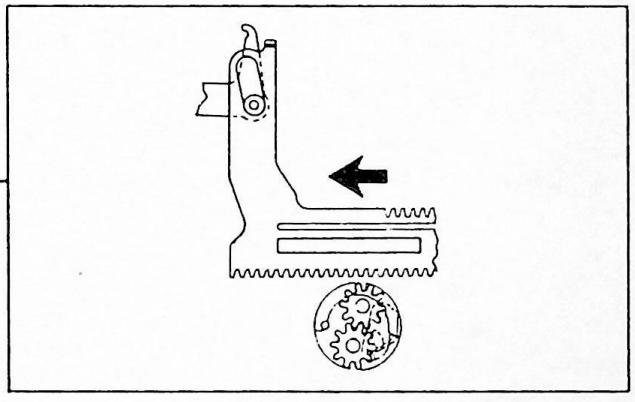
TOTAL KEY (cont'd.)

The figure is printed...



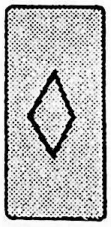


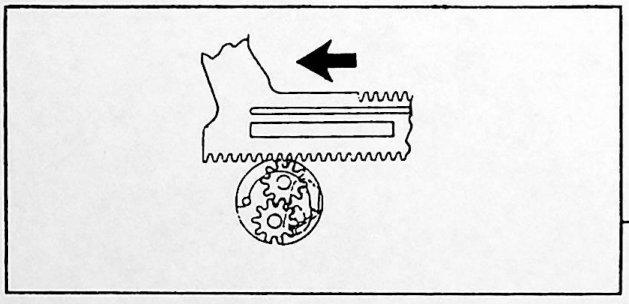
The accumulator then disengages...



...and the racks move forward to neutral.

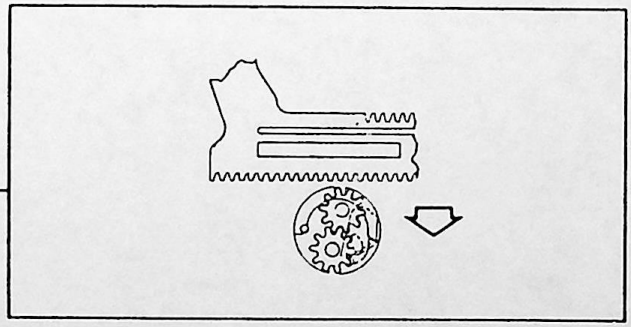
SUB-TOTAL KEY

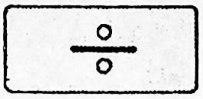


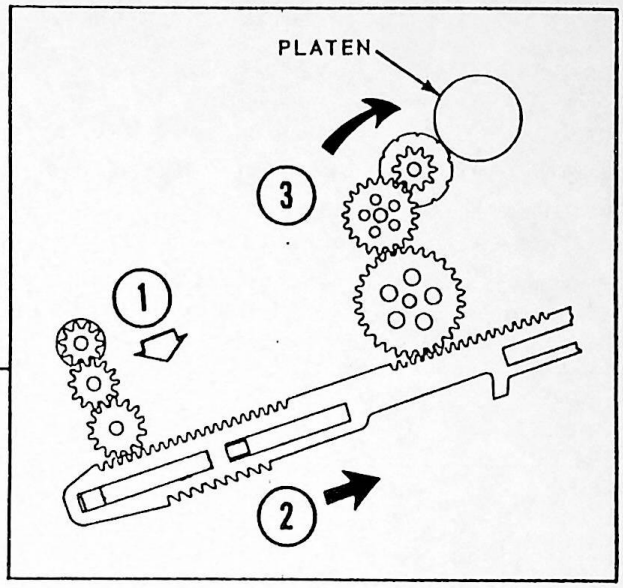


Same as the total key except: The accumulator remains engaged with the racks as they move forward to neutral. This causes the figure to be re-entered in the accumulator.

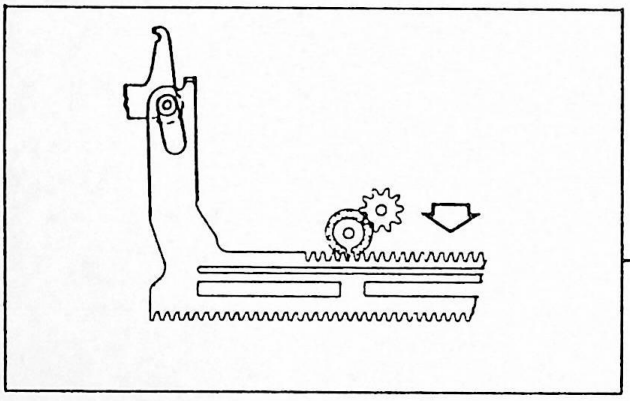
After the racks have restored to neutral, the accumulator disengages.



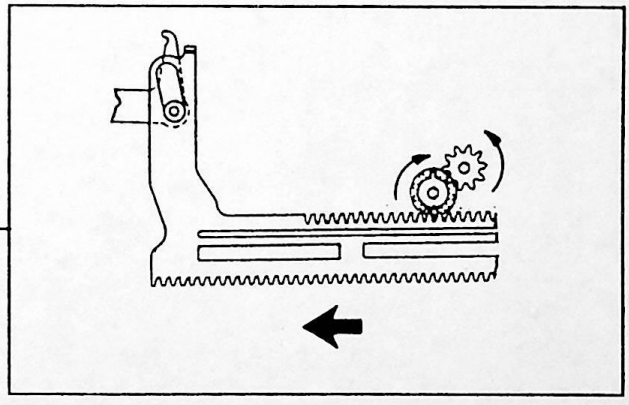
ENTER DIVIDEND KEY 



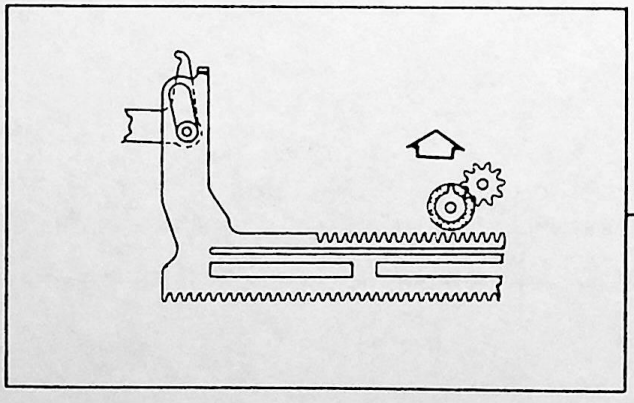
This operation starts out the same as most of the others. Set-up carriage moves down (1)...racks move rearward (2)...and figures print (3).



With the racks at their rearward position the register moves down into engagement with the rear racks...



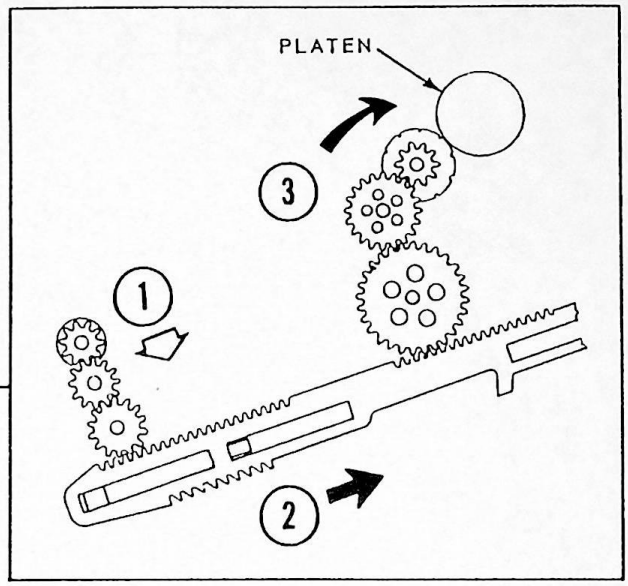
and the figure is entered in the register as the racks move forward to neutral.



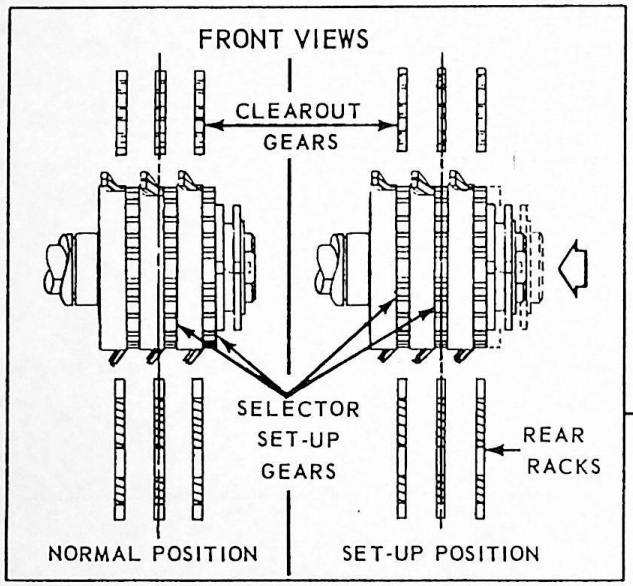
The register then disengages.

NOTE: The register carry mechanism does not operate on entries from racks...so this unit cannot be used to accumulate.

ENTER MULTIPLICAND KEY [X]



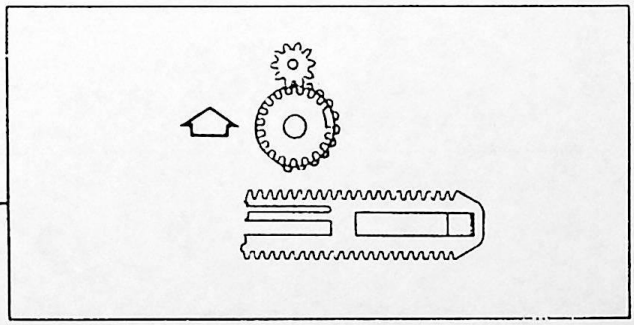
Again the first series of movements is the same...
Set-up carriage down (1)... racks to the rear (2)... and figure printed (3). However, while this was taking place, several other things were happening:

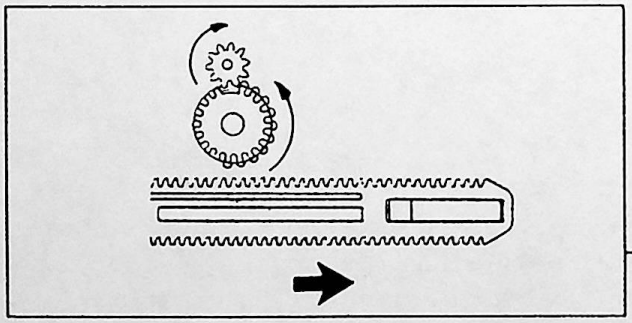


The selector was moved from its normal position... a little to the left, so that the selector set-up gears were in sidewise alignment with the clearout gears and the rear racks.

NOTE: This mechanism is described in detail under "Enter Multiplicand Key".

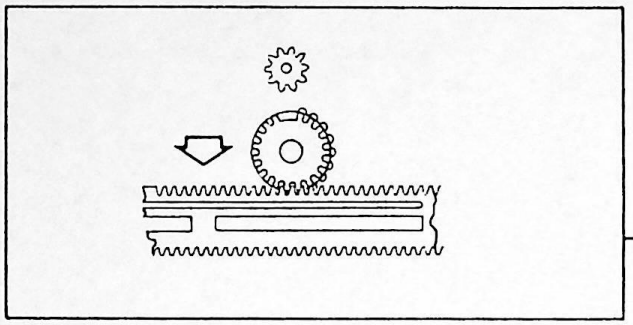
The selector was then moved up into engagement with the clearout gears and...





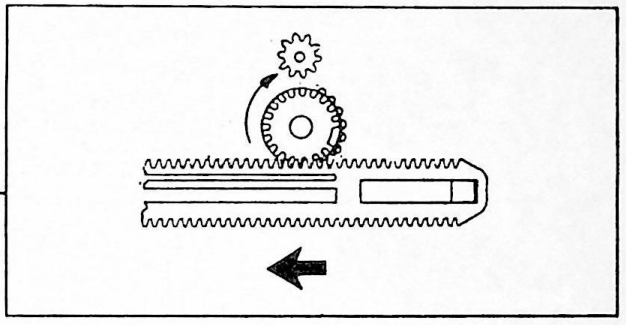
...any figure that may have been in the selector was removed by the clearout gears. This took place as the racks were moving to the rear.

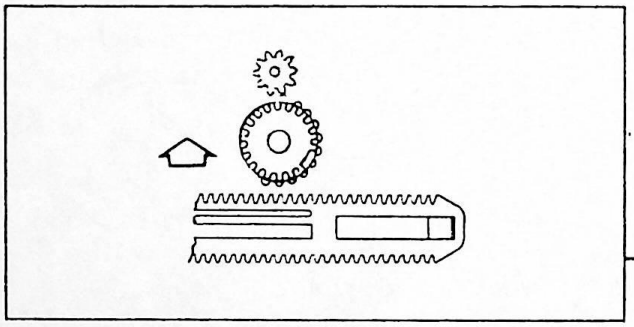
ENTER MULTIPLICAND KEY (cont'd.)



With the racks in their rearmost position, the selector moves down, out of engagement with the clearout gears and into engagement with the rear racks.

The racks move forward to neutral... entering the figure in the selector.

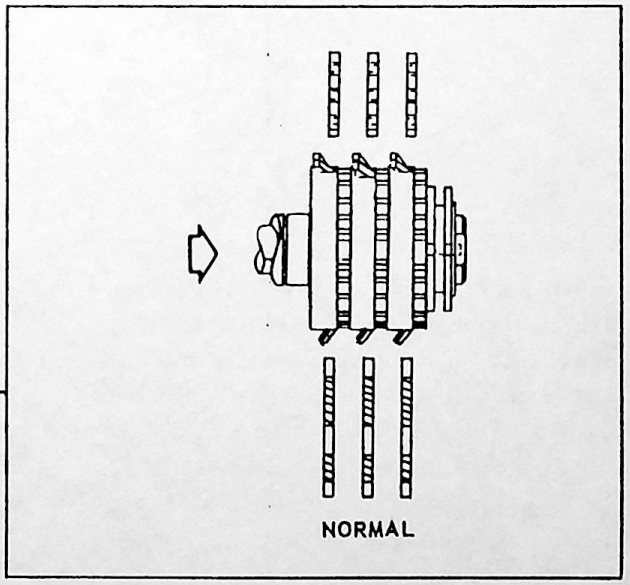




When the racks reach their neutral position, the selector moves up, out of engagement...to its normal vertical position.

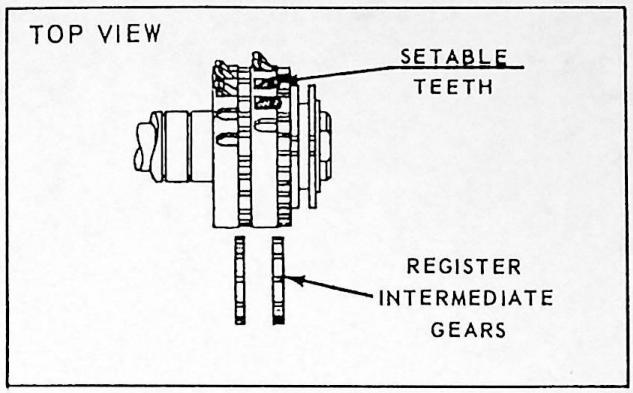
The selector now moves horizontally a little to the right...back to its normal horizontal position.

NOTE: This mechanism is described in detail under "Enter Multiplicand Key".

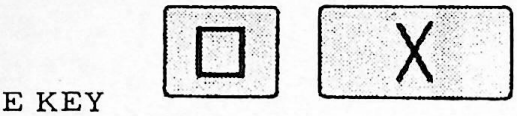


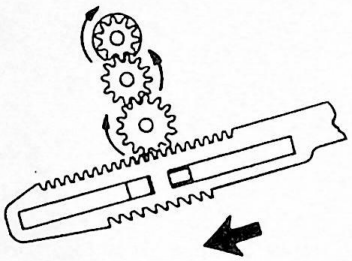
ENTER MULTIPLICAND KEY (cont'd.)

In this position the selector set-up gears have moved out of sidewise alignment with the clearout gears and rear racks so that the setable teeth of the selector (that represent the figure entered) are aligned to engage the register intermediate gears.



SQUARE KEY

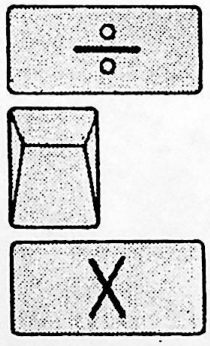




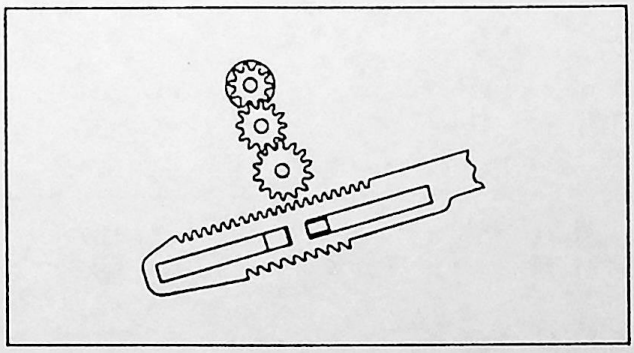
This key is used with the enter multiplicand key or any of the three multiplication keys. Its function is the same as the REPEAT key used with plus or minus. That is, it keeps the set-up carriage engaged with the front racks after the figure has been entered in the proper place so that the figure is re-entered in the set-up carriage as the racks move forward to neutral. It also disables the set-up carriage return mechanism.

NOTE: The Square Key, Transfer Key and Repeat Key are "dead" keys. By this we mean that nothing will happen if they are depressed by themselves. They must be used in conjunction with one of the "live" keys shown with them.

TRANSFER KEY

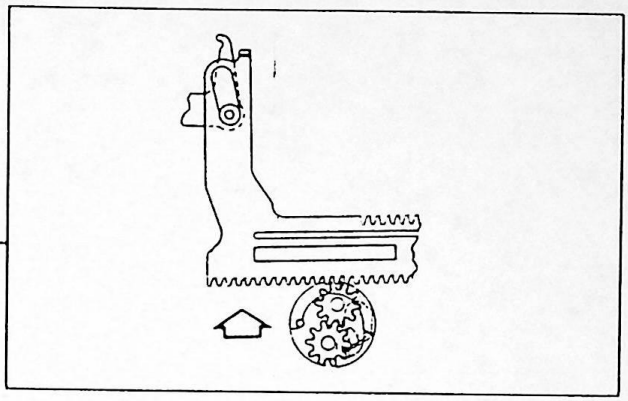


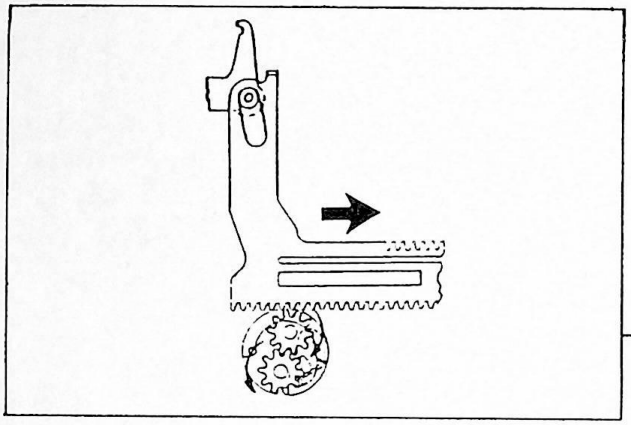
This key is used with either the Enter Dividend Key or the Enter Multiplicand Key. Its purpose in either case is to use the amount stored in the accumulator, instead of the set-up carriage, for the entry. Therefore, when the Transfer Key is used, the set-up carriage does not move down into engagement with the front racks...



TRANSFER KEY (cont'd.)

...instead, the accumulator moves up into engagement with the rear racks.

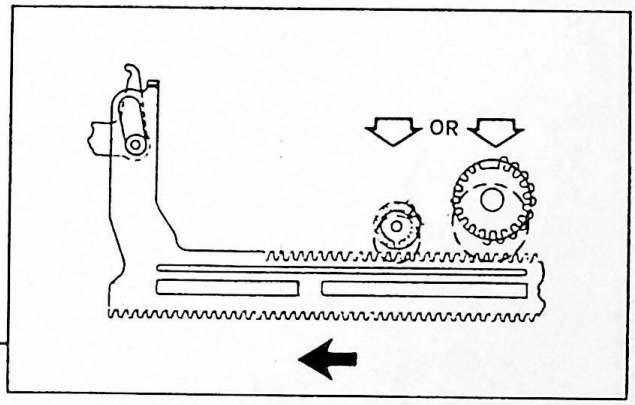




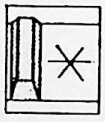
As the racks move to the rear, the figure is removed from the accumulator.

NOTE: The point at which the accumulator disengages depends upon the position of the Transfer Total Lever (see below).

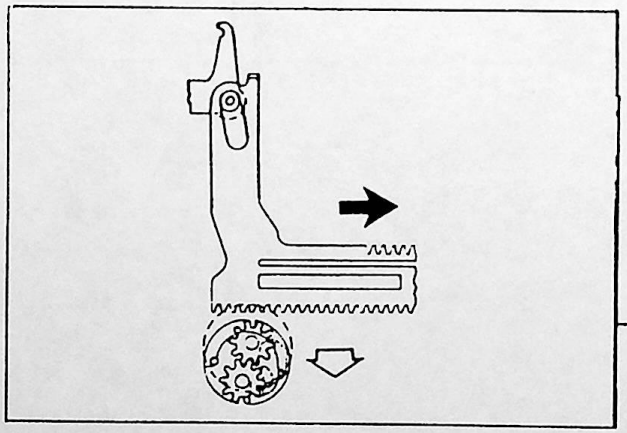
As the racks move forward to neutral, the figure is then entered in either the register (transfer dividend) or the selector (transfer multiplicand).



TRANSFER TOTAL LEVER

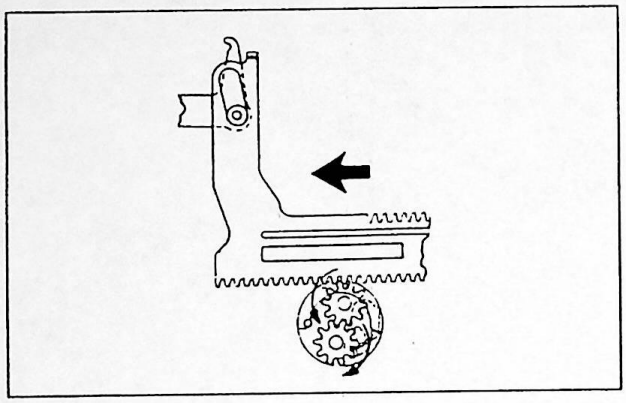


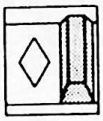
Another control that affects the transfer operation is the slide button located above the enter dividend key on the keyboard. It is called the Transfer Total Lever.



With this slide button to the left (total position) the accumulator will move out of engagement with the racks when they reach their rearmost position on a transfer operation.

TRANSFER TOTAL LEVER (cont'd.)

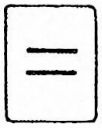


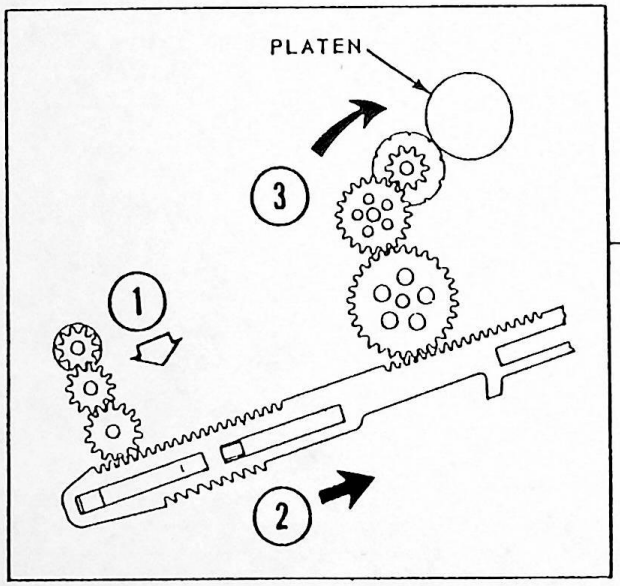


With the slide button to the right (sub-total position) the accumulator will remain in engagement with the racks as they move forward to neutral. This causes the figure to be re-entered in the accumulator at the same time it is being entered in the register or selector.

When the racks have been moved to their forward position, the accumulator will move out of engagement.

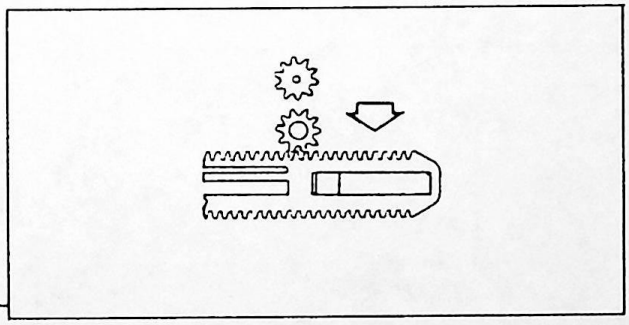
MULTIPLICATION KEY

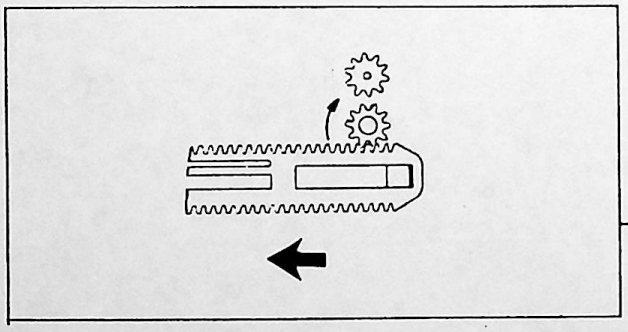




Again the first three steps are: set-up carriage down (1), racks to the rear (2) and printing of figure (3).

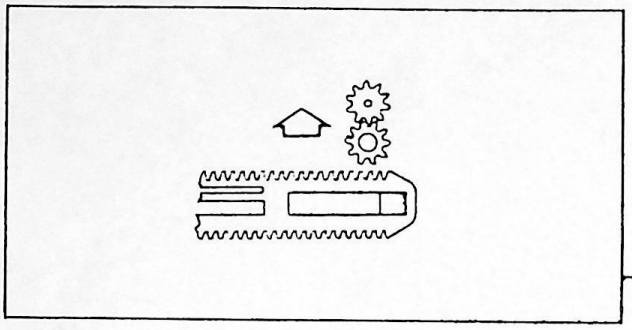
With the racks in their rearmost position the multiplier/quotient gears move down into mesh with the rear racks.





As the racks move forward to neutral, the figure is entered in the multiplier gears.

MULTIPLICATION KEY (cont'd.)



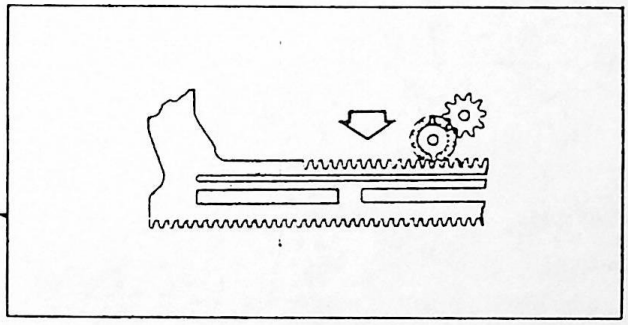
When the racks reach their neutral position the multiplier gears disengage. At this point the automatic control mechanism takes over and the machine starts high speed multiplication.

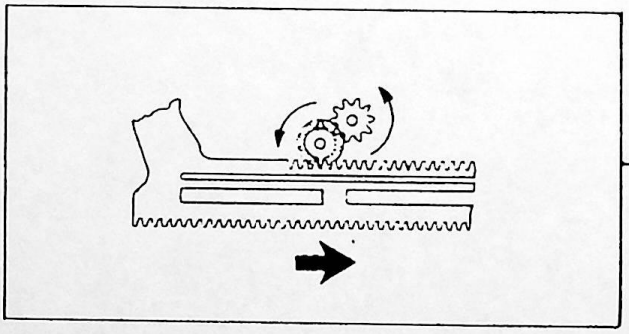
The details of multiplication will be fully covered later. For now it will be enough to know that the selector, which shifts from right to left, stops at each column in which a digit has been entered in the multiplier gear. It cycles a number of times in relation to this multiplier digit. This cycling causes the multiplier gear to be counted to its "zero" position, and adds an amount from the selector to the register gears on each cycle. A high speed carry mechanism adds whatever carry-overs are called for to the register near the end of each cycle. The register gears therefore, accumulate the product of the multiplication.

When the last multiplier gear containing a digit is counted to "zero", the selector starts to shift to the right... to its 'home' position.

While the selector is returning to its 'home' position...

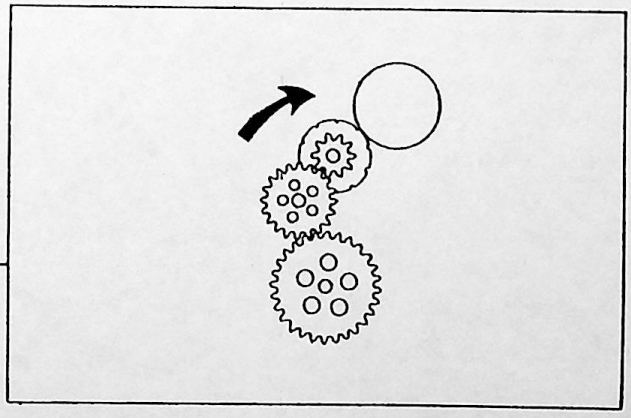
...the register moves down into engagement with the racks.



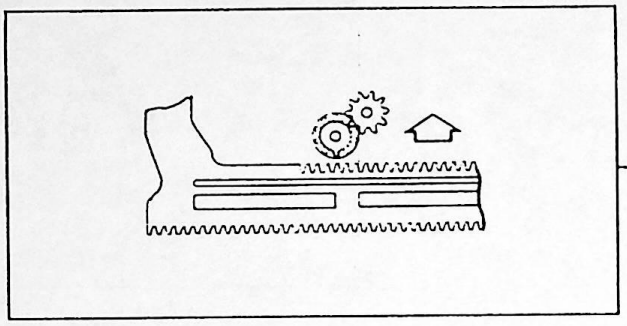


The racks again move to the rear, removing the product from the register.

With the racks at their rearward limit the product prints.

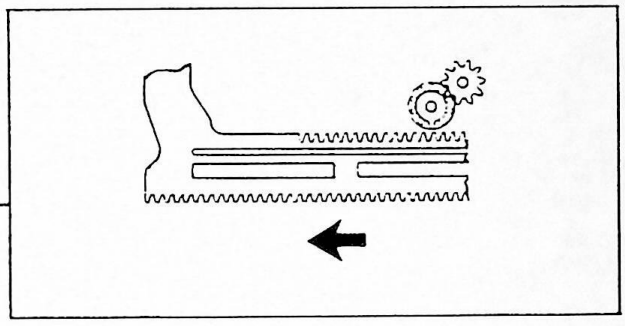


MULTIPLICATION KEY (cont'd.)

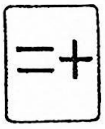


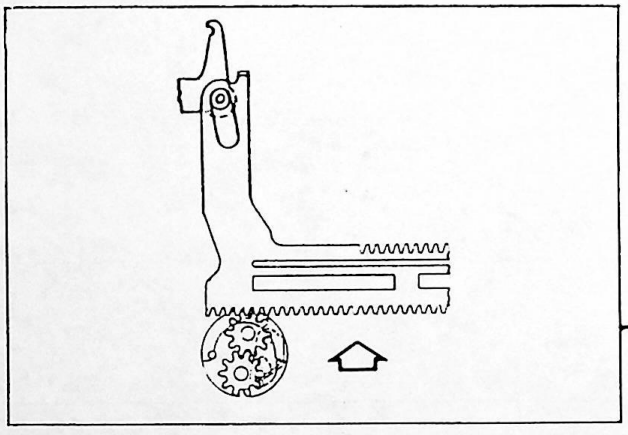
The register then disengages...

...and the racks move forward to neutral.



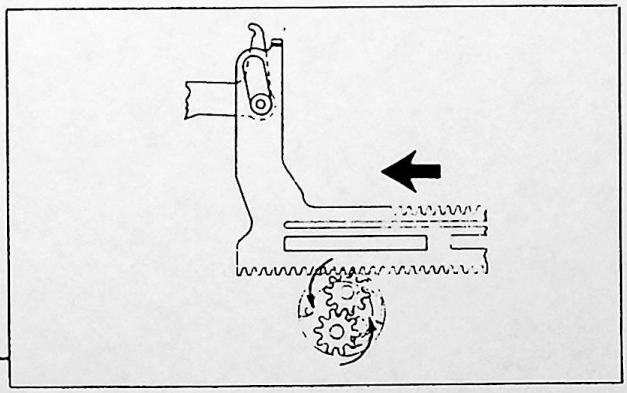
ACCUMULATIVE MULTIPLICATION KEY





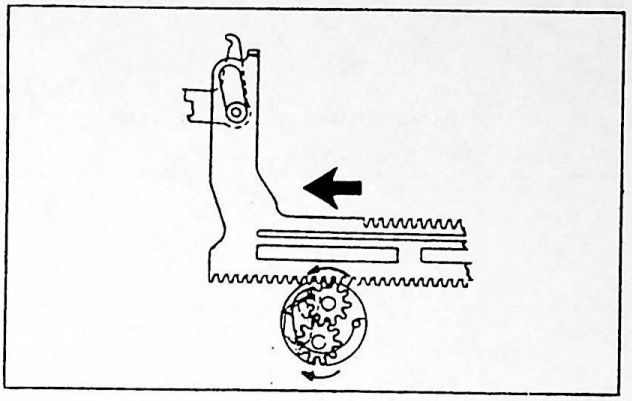
Same as Multiplication key except: On the final machine cycle, with the racks in their rearmost position (having removed the product from the register), the accumulator moves up into engagement with the rear racks.

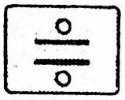
As the racks move forward to neutral, the product is added to the plus accumulator gears. This phase of the final cycle of accumulative multiplication, is exactly the same as the second half of the plus cycle.



NEGATIVE MULTIPLICATION KEY

Same as Accumulative Multiplication Key except:
The product is added to the minus accumulator gears instead of the plus gears and the product prints in red.



DIVISION KEY 

The first machine cycle of this operation is exactly the same as the complete "Enter Multiplicand" operation...that is...the figure in the set-up carriage is entered into the selector.

At this point the automatic control mechanism takes over and the machine starts high speed division.

The details of division will be fully covered later. The following brief description of this operation will suffice for now.

As you know from the description of the "Enter Dividend" operation, the dividend is contained in the register...the divisor was entered in the selector as explained in the first paragraph of this operation.

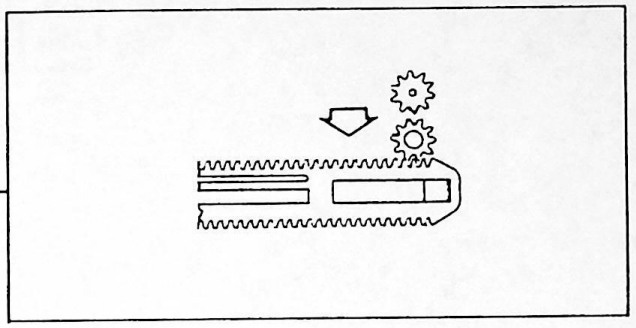
The selector is now shifted to the left until the first column setable selector gear is aligned with the tenth column register gear. (This also aligns a counting gear on the selector carriage with the tenth column multiplier/quotient gear).

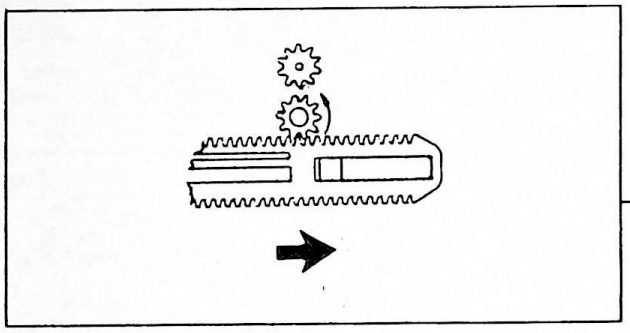
The selector cycles...subtracting * the divisor (selector) from the dividend (register) until the amount of the divisor exceeds the dividend as aligned. The number of cycles this takes is counted into the tenth column multiplier/quotient gear. The selector now adds the divisor back into the dividend once (this removes one count from the multiplier /quotient gear) and shifts to the right one column so that it is aligned with the ninth column of the register...Again the selector cycles...subtracting* the divisor from the dividend as before. This sequence continues thru all columns to the right. When it is completed in the first column, the multiplier/quotient gears contain the quotient and the register contains the remainder of the division.

*NOTE: We have referred to "subtracting" the divisor from the dividend. Actually the selector does not "subtract" by either of the two mechanical means, which you are most likely aquainted with since it cycles in only one direction and the register does not contain a set of complementary "minus" gears. However, the selector itself contains the complement of the divisor (as well as the divisor) and it accomplishes the same effect as subtraction by adding the complement of the divisor to the register gears...(More on this later).

DIVISION KEY (cont'd.)

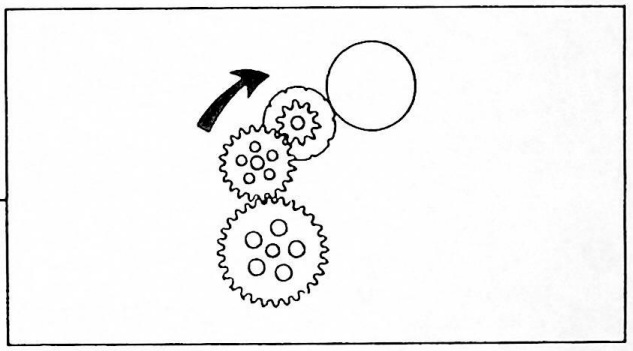
The multiplier/quotient gears now move down into engagement with the racks...

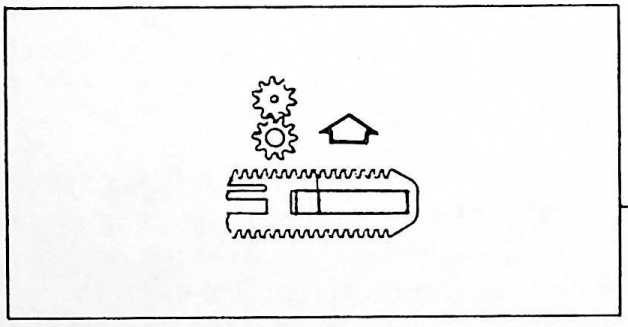




...the racks move rearward, removing the quotient...

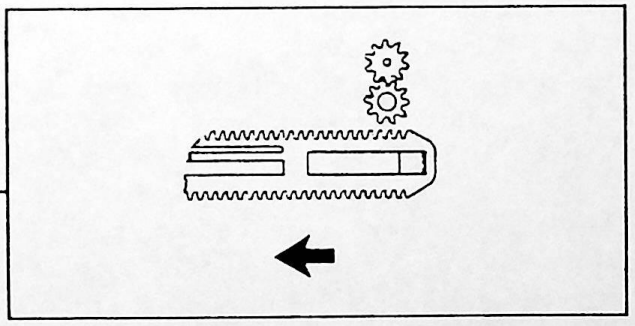
...the quotient prints...





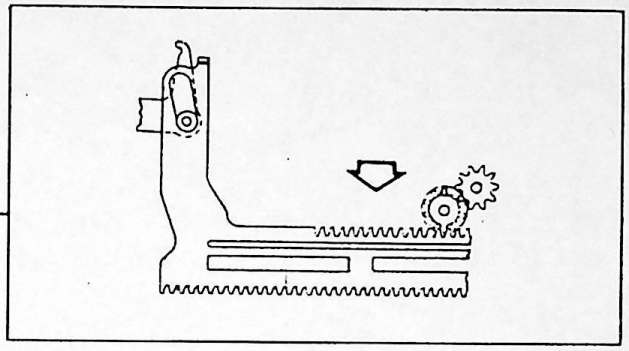
...the multiplier/quotient gears disengage...

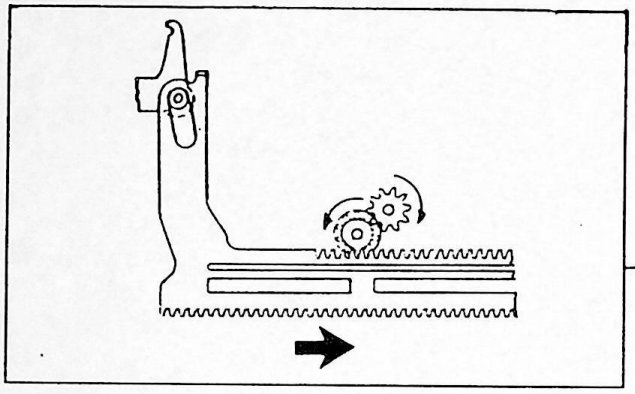
...and the racks move forward to neutral.



DIVISION KEY (cont'd.)

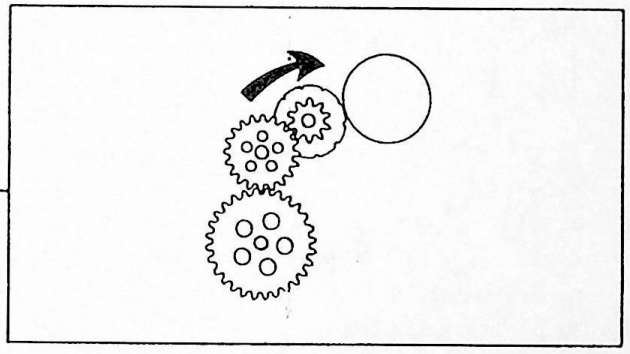
With the quotient printed and the racks in neutral...
...the register moves down into engagement with the racks...

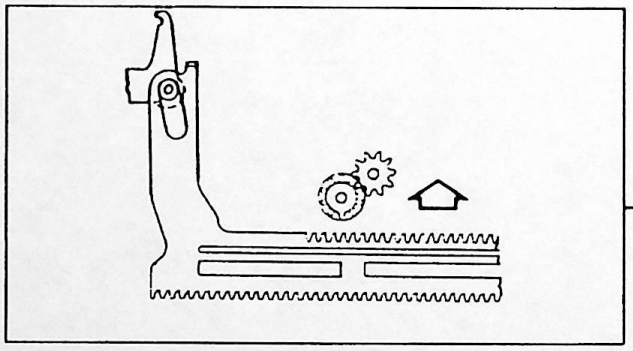




...the racks move rearward, removing the remainder...

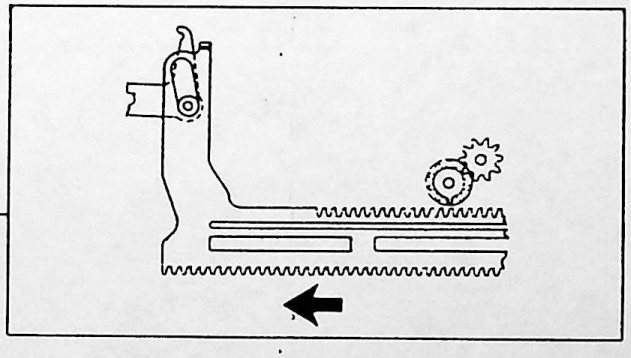
...the remainder prints...





...the register disengages...

...and the racks move forward to neutral.



CONSTANT DIVISOR/QUOTIENT TRANSFER LEVER

This lever is located at the right front corner of the keyboard.

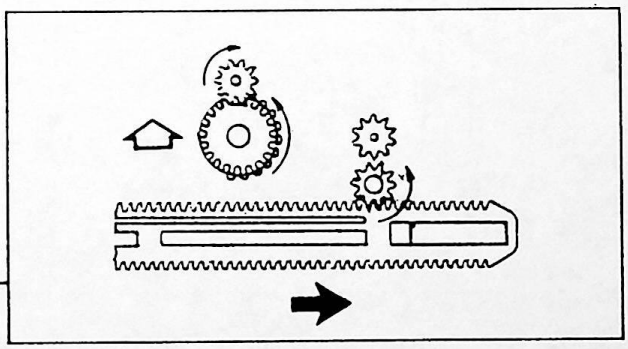
It is shown here in the "Constant Divisor" position.

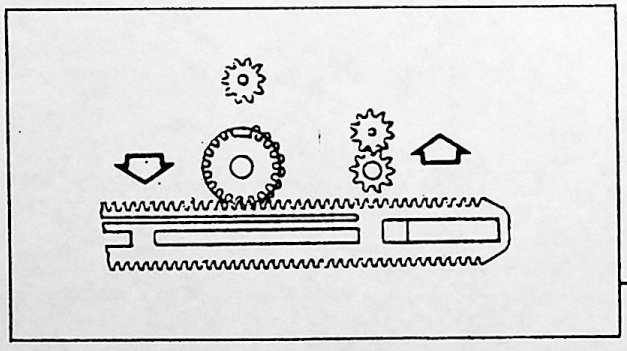
This simply means that the last amount entered in the selector will remain in the selector until such time as either the Division (÷) or Enter Multiplicand (×) Key is depressed with an entry in the set-up carriage. If either key is depressed without an entry in the set-up carriage, the selector set-up (as described under "Enter Multiplicand") is disabled and the amount in the selector remains as a constant. This disabling arrangement has been provided to permit the use of a constant divisor.

The lever is shown here in the "Quotient Transfer" position.

In this position the selector set-up (as described under "Enter Multiplicand") is activated on the quotient cycle of a division operation. There is one thing that is different, however, from the "Enter Multiplicand" cycle...That is, the rearward movement of the racks is controlled by the multiplier/quotient gears...not the set-up carriage.

The selector is cleared by the clearout gears as the racks move rearward, removing the quotient from the multiplier/quotient gears.

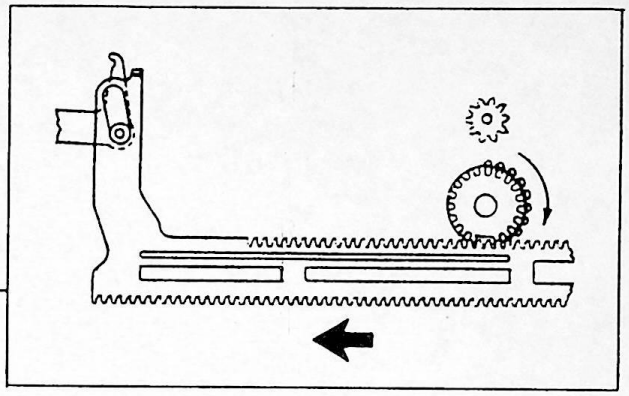




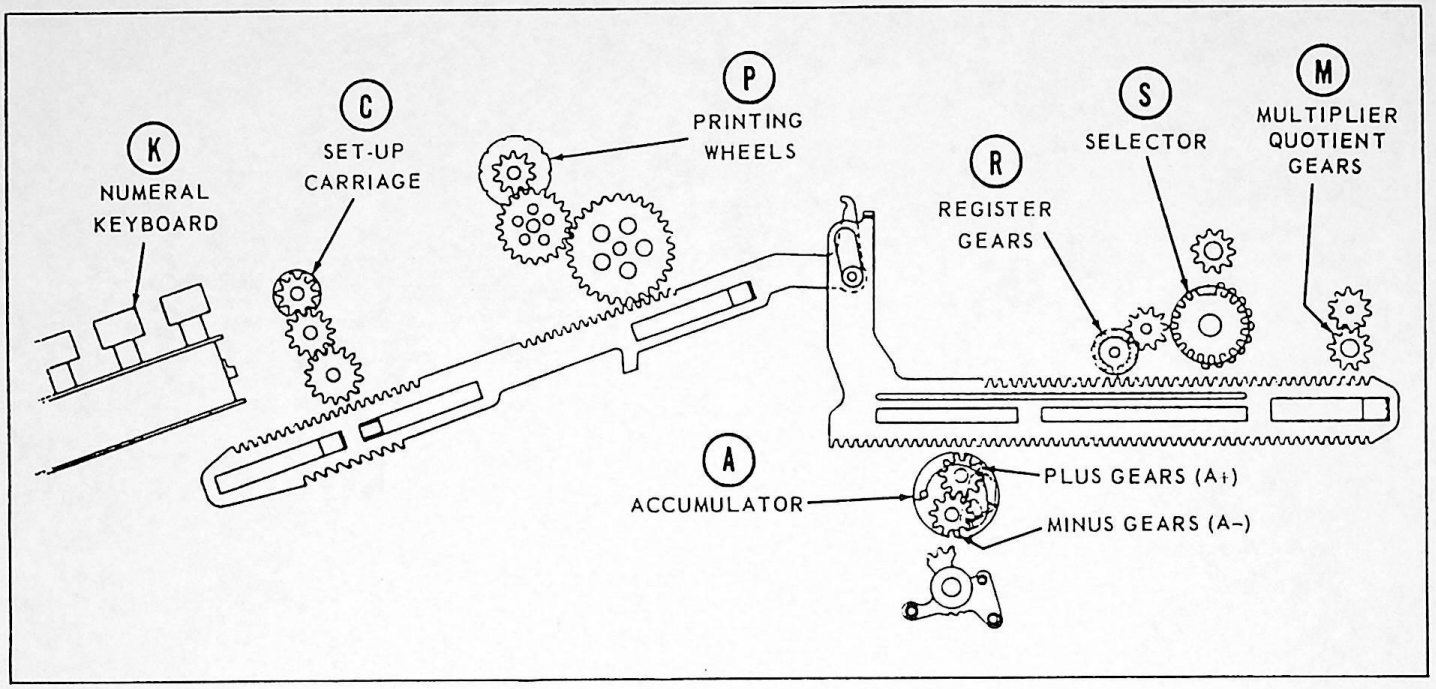
When the quotient is printed the selector engages the racks and the multiplier/quotient gears disengage.

CONSTANT DIVISION / QUOTIENT TRANSFER LEVER (cont'd.)

The quotient is set-up in the selector as the racks move forward to neutral.



The selector then disengages and the remainder cycle takes place as described at the end of the division operation.



KEY/S	FROM	TO	ALSO
1 2 3 ETC.	K	C	
C	C		
∅	C	P	
+	C	P & A+	
+	C	P & A+	RETURNS TO C
–	C	P & A–	
–	C	P & A–	RETURNS TO C
*	A	P	
0	A	P	RETURNS TO A
±	C	P & R	
X	C	P & S	
0 X	C	P & S	RETURNS TO C
+ with *	A	P & R	
+ with 0	A	P & R	RETURNS TO A
X with *	A	P & S	
X with 0	A	P & S	RETURNS TO A.

KEY/S	FROM	TO	ALSO
÷	C	P & M	
PRODUCT	R	P	
·	C	P & M	
PRODUCT	R	P & A+	
×	C	P & M	
PRODUCT	R	P & A–	
1 ÷ –	C	P & M	RETURNS TO C
PRODUCT	SAME AS ABOVE FOR MULT. KEY USED		
÷ with ÷ X	C*	P & S	
QUOTIENT	M	P	
REMAINDER	R	P	
÷ with * X	C	P & S	
QUOTIENT	M	P & S	
REMAINDER	R	P	

* IF NO ENTRY IS MADE IN SET-UP CARRIAGE, THE LAST SELECTOR ENTRY REMAINS AS A CONSTANT

Here is our diagram again, with a chart that pretty well summarizes what has been said on the preceding pages.

SECTION II

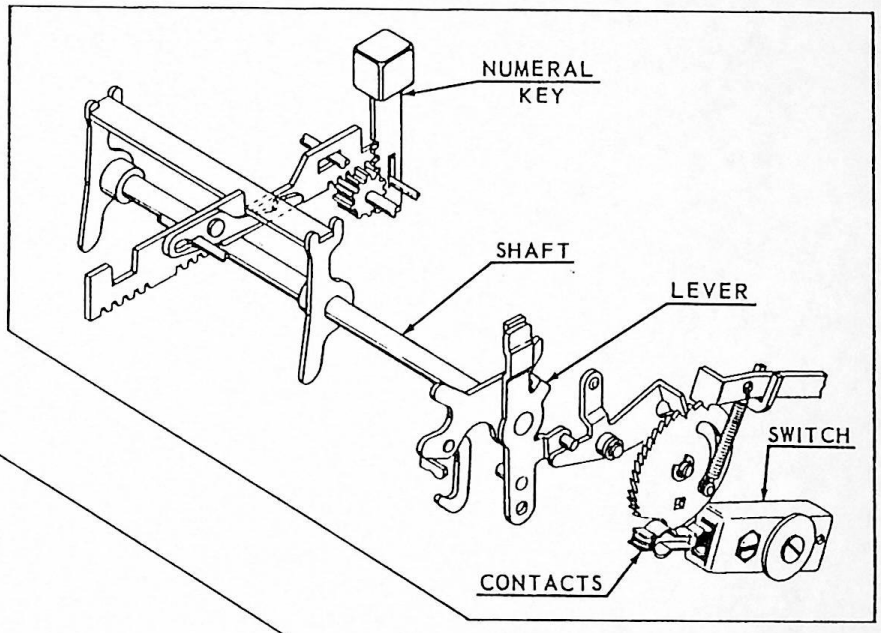
DRIVE MECHANISM

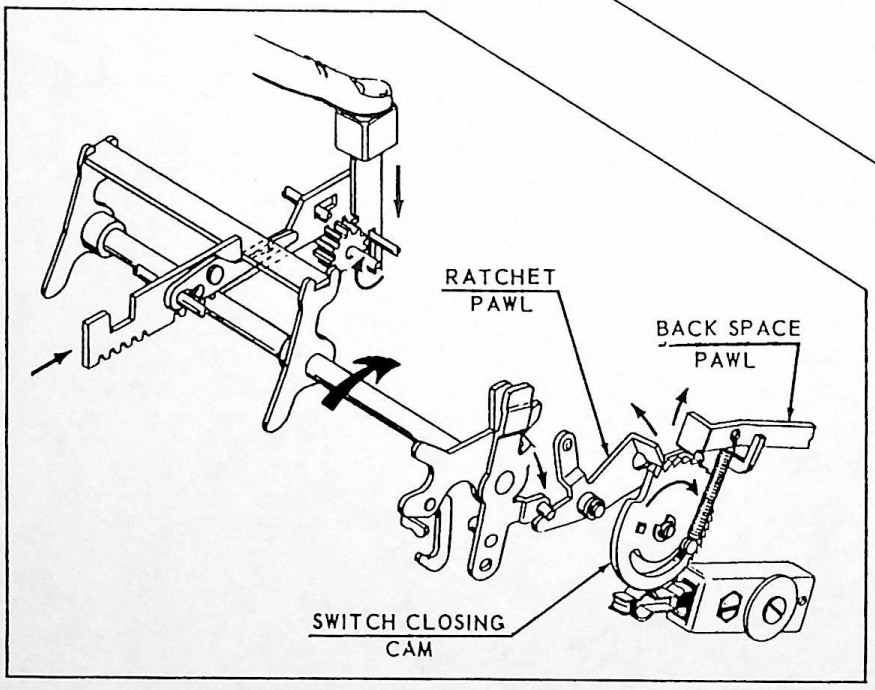
The start and stop switch is of the exposed contact spring blade type; the same type that has been used for years in various other models.

One innovation is the use of a switch opening delay mechanism. This keeps the switch closed and motor running for a few seconds after the end of each operation.

Since this model employs a power operated numeral set-up arrangement, the switch is closed upon depression of any numeral key as well as any of the "live" operating keys.

NUMERAL KEY NORMAL
Switch Open →



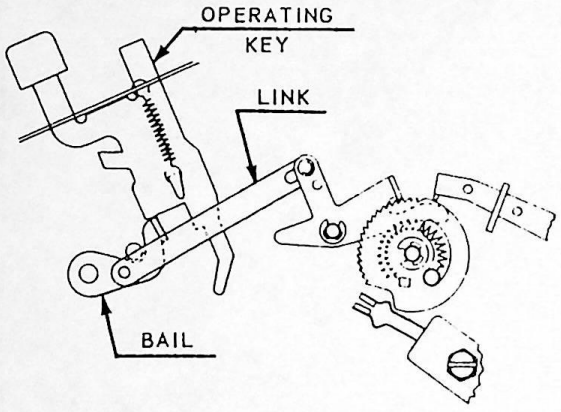


NUMERAL KEY DEPRESSED
← Switch Closed

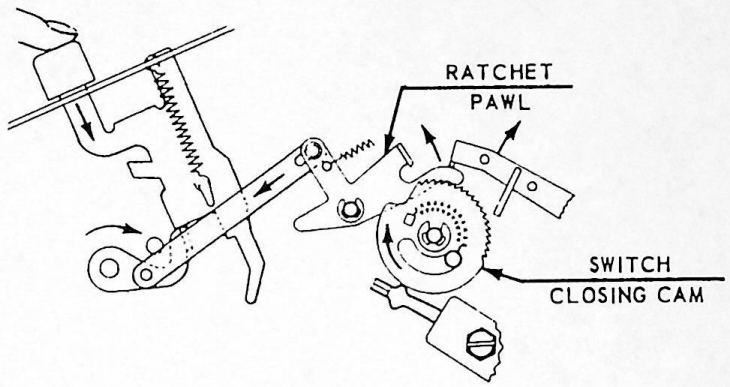
The switch is closed from the numeral keyboard by means of a shaft which is pivoted clockwise whenever a numeral key is depressed. A lever on the right end of the shaft contains a stud, which in turn, pivots a pawl out of engagement with the ratchet teeth on the switch closing cam. An extension of this ratchet pawl also lifts the back space pawl out of engagement with the teeth.

The switch closing cam is pivoted clockwise by a spring, closing the switch contacts.

The switch is closed upon depression of any "live" operating key by means of a bail which extends across the front of the machine under both the right and left control keyboards. The bail is pivoted clockwise by the operating keystems. A link attached to the right arm of this bail is also connected to the ratchet pawl that is engaged with the ratchet teeth of the switch closing cam. Pivoting of the bail therefore pulls the link forward and pivots the pawl out of engagement with the same result as described previously for the numeral keyboard.



OPERATING KEY NORMAL
Switch Open

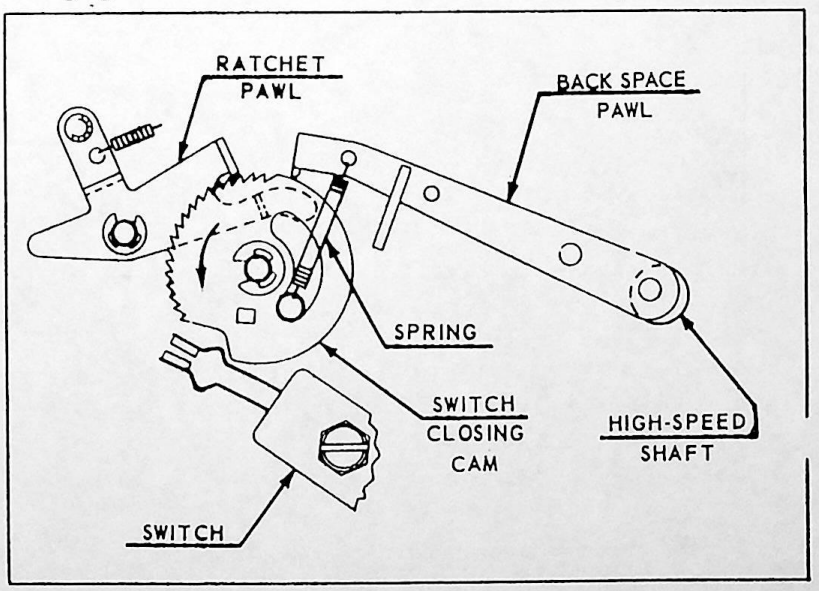


OPERATING KEY DEPRESSED
Switch Closed

Upon completion of the numeral set-up or operation cycle, the ratchet pawl is released. Both the ratchet pawl and back space pawl are pulled down into engagement with the ratchet teeth by their springs.

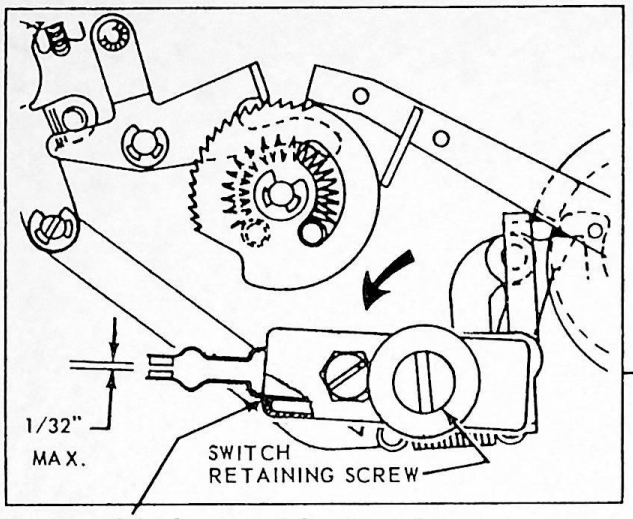
The back space pawl is attached to an eccentric extension on the end of the high speed shaft. This eccentric imparts a reciprocating motion to the pawl whenever the motor is running. With the pawl engaged in the ratchet teeth, the reciprocating action turns the switch closing cam in a counterclockwise direction until the notch of the cam positions over the hump on the upper switch blade. This allows the switch contacts to open and the motor stops.

The ratchet pawl serves to catch each succeeding ratchet tooth as the switch closing cam is turned counterclockwise by the back space pawl.



Adjustment

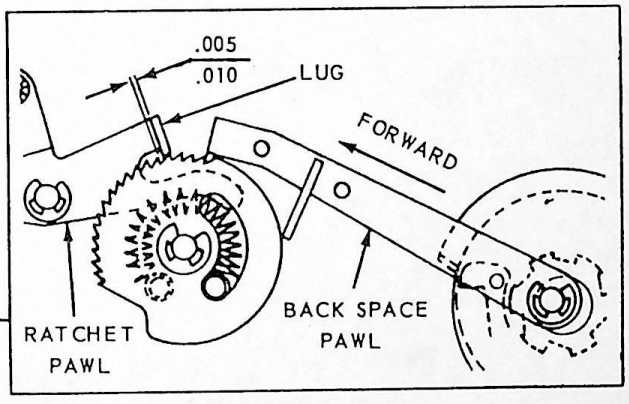
1. Remove motor cord...Clean contact points with contact cleaner (K. T. #206).

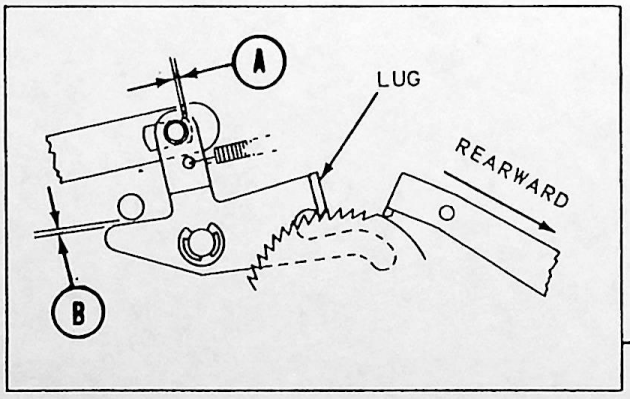


Lower blade must be touching at this point.

2. Loosen switch retaining screw and turn switch away from cam. Check that lower switch blade touches lower edge of opening in housing. Check that contact points are parallel... properly aligned...and have 1/32" maximum gap between them. Adjust by forming switch blades.

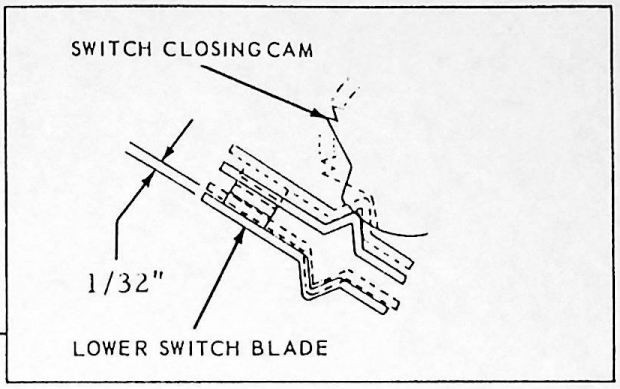
3. Cycle back space pawl to its fully forward position and check for slight clearance (from .005 to .010) between ratchet tooth and lug of ratchet pawl. Adjust by forming lug forward or rearward.

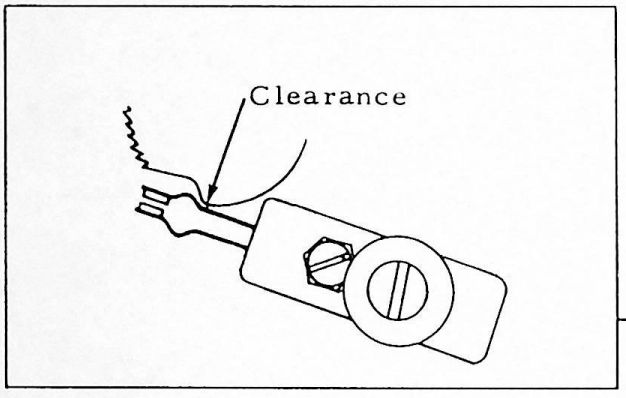




4. Cycle back space pawl to its fully rearward position and check that lug of ratchet pawl engages to full depth of ratchet tooth...To insure full depth of hold, ratchet pawl should have slight clearance at link (A) and stud (B). Adjust by forming lug up or down.

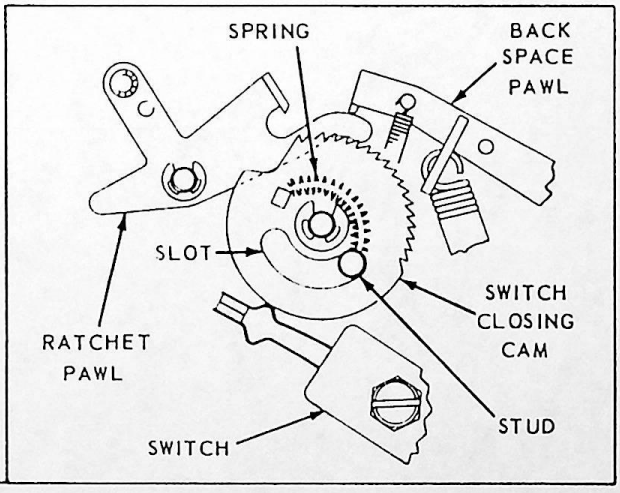
5. Position switch in relation to switch closing cam to obtain approximately 1/32" overtravel of lower switch blade when switch is closed... Tighten switch retaining screw... After making this adjustment, check the following:





a. With switch closing cam in restored position and held by ratchet pawl (not back space pawl) the cam should not touch upper switch blade... check for clearance.

b. With ratchet pawl lifted to close switch, switch closing cam should be turned by its spring until the end of its slot limits on spring stud... If switch had been adjusted for too much overtravel of lower blade, or if spring on switch closing cam is weak, the back-pressure from the spring blades of the switch might prevent cam from turning, ...If this occurs, re-adjust overtravel or strengthen spring as required.



Please insert this supplementary page following page II-A-4 in your copy of C.S.B. #P2-502.

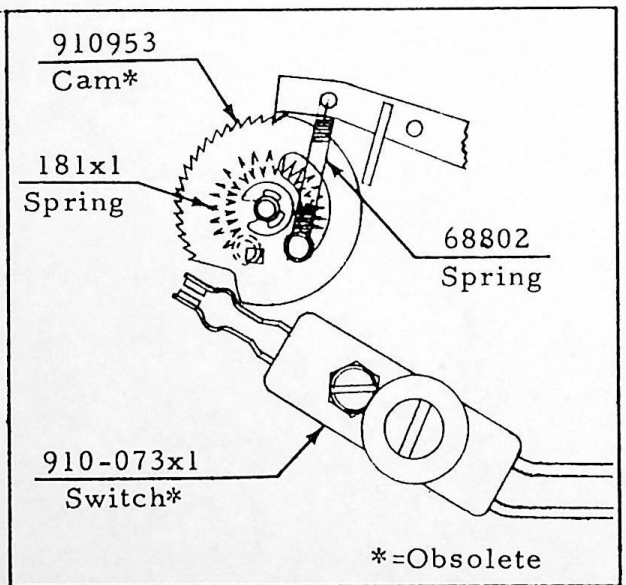
The switch mechanism has been revised to reduce the time required by the time delay feature to open the switch contacts. This change has been requested by the Sales Department to minimize possible objection from customers who are accustomed to the sound of the motor stopping as a signal that the operation has been completed.

Four parts have been changed to accomplish this revision. They are:

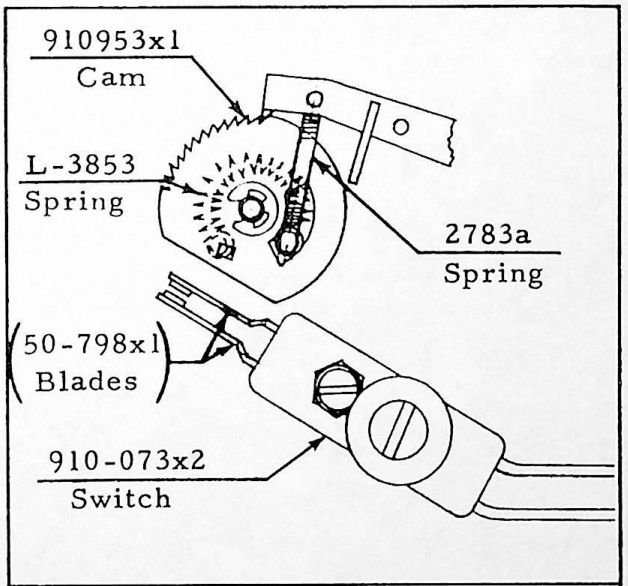
1. Switch Closing Cam (910953x1 replaces 910953)
2. Switch (910-073x2 replaces 910-073x1)
3. Switch Closing Cam Spring (L-3853 replaces 181x1)
4. Back Space Pawl Spring (2783a replaces 68802)

Please post the above part number changes on page 70-2 in your copy of the Temporary Parts Catalog.

The Switch Closing Cam has been re-designed. Its escapement slot has been shortened...the number of ratchet teeth reduced...and the switch actuating contour revised to function with the "flat" switch blades.



PREVIOUS STYLE PARTS



REVISED PARTS

The switch revision consists of a change in the switch blades. The blades with the "hump" forming, previously used, have been replaced by the standard flat switch blades (50-798x1) which are common to all our other switches of this type. In addition to the obvious advantage of standardization, use of the flat blades will also eliminate wear by distributing the wiping action of the switch closing cam over a much larger area of the upper switch blade.

The previously used switch closing cam spring and back space pawl spring have been replaced by somewhat stronger springs to insure proper operation with the revised switch and cam.

Beginning with serial number B-861043, all subsequent production of 211PC192 machines will contain these revised parts.

It is NOT necessary to "update" machines equipped with the previous style switch closing cam and switch so long as they are operating satisfactorily....However, if it becomes necessary to replace either the previous style cam or the previous style switch, then ALL FOUR REVISED PARTS should be installed.

Material to Requisition:

Amt.	Part No.	Name
1	L-3853	Spring
1	2783a	Spring
1	910953x1	Cam
either 1*	910-073x2	Switch
or 2*	50-798x1	Blades

*NOTE: Previous style switches can be converted to the revised style by dismantling the switch...unsoldering the old blades from the wire leads...soldering a pair of flat blades in their place...and re-assembling the switch. This procedure may prove more convenient than installing a new switch.

The previous style cam and switch are obsolete and will no longer be available on requisition.

The adjustment procedure outlined on pages II-A-3 and II-A-4 still applies to the revised mechanism.

Supplement of 6-28-65

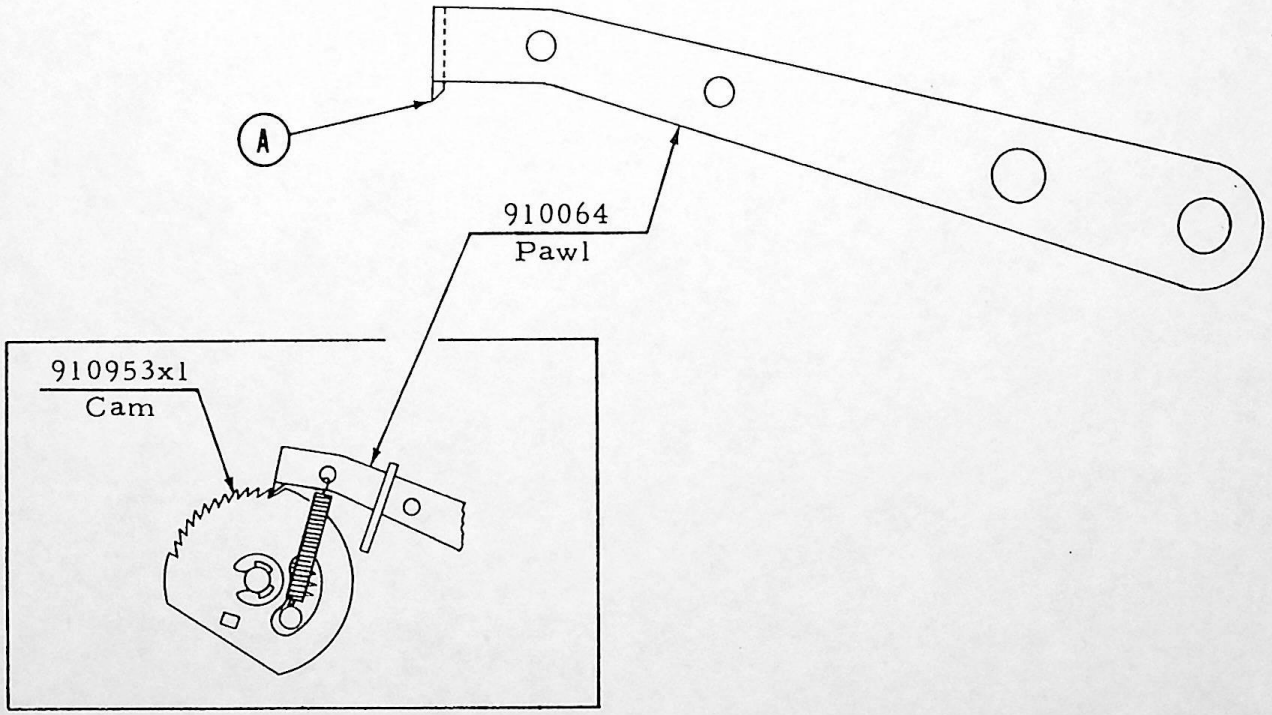
Please insert this supplementary page following page II-A-6 in your copy of C.S.B. #P2-502.

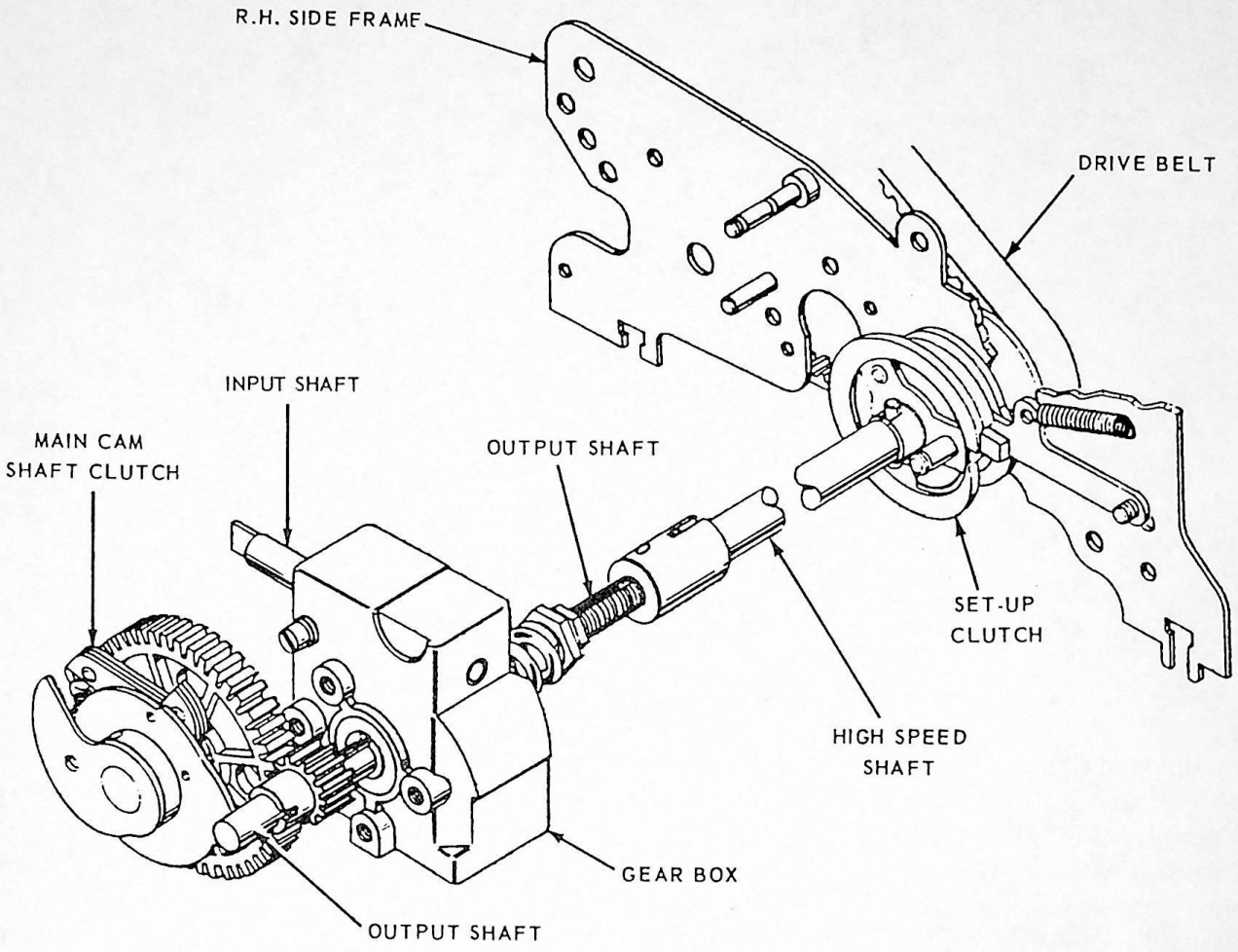
Evidence of wear on the teeth of switch closing cam (910953 or 910953x1) has been encountered in some machines.

The cause of this wear has been traced to an extremely sharp edge (A) on the back space pawl (910064).

To correct this condition, stone off the sharp edge on the pawl.

Note: Always check for this condition when installing the revised switch closing cam (910953x1).

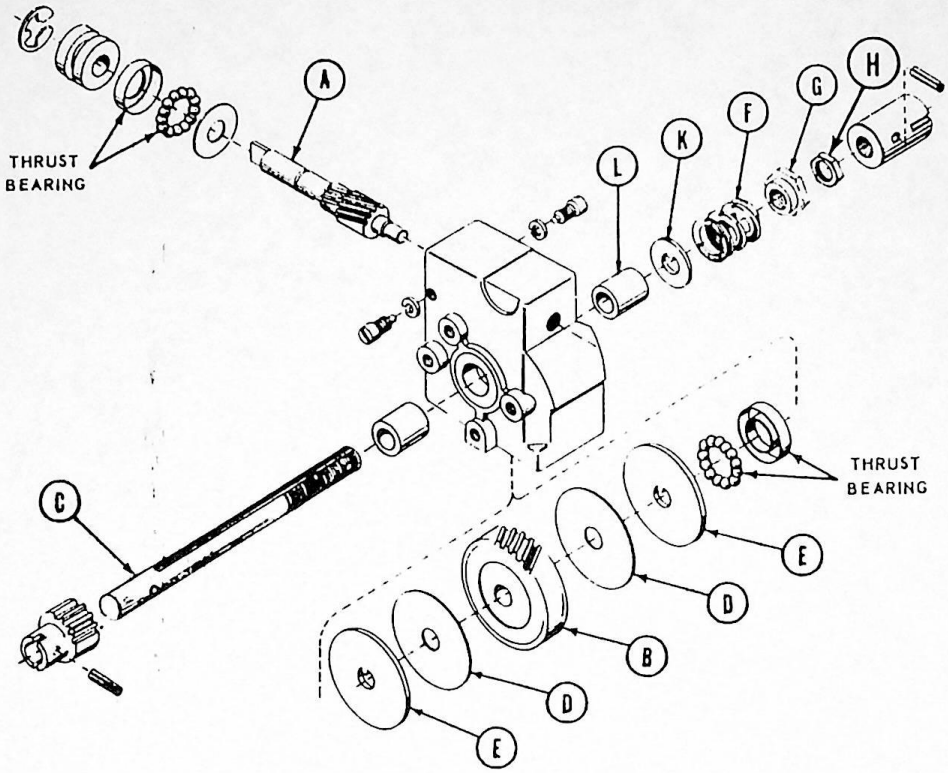




The closing of the switch starts the motor. The motor is coupled to the input shaft of the gear box. The input (motor) speed of more than 3000 cycles per minute is reduced in the gear box to a little over 800 cycles at the output shaft. Power is taken off from both ends of the output shaft, which extends thru the gear box and contains the friction drive clutch.

The left end of the output shaft contains a small gear, which turns a large plastic gear. The large plastic gear is attached to the drive gear of the main cam shaft clutch. The ratio of the small output shaft gear to the large plastic gear further reduces the speed so that when the main cam shaft clutch is engaged the main cam shaft will cycle at approximately 200 cycles per minute.

The right end of the output shaft is coupled to an extension shaft, which we call the "high speed" shaft. The drive gear for the numeral set-up clutch is attached to this high speed shaft. The shaft also turns the geared drive belt for the shift and cycle clutches in the high speed calculating section. On the extreme right end of this shaft is an eccentric extension, which drives the back-space pawl for the switch closing cam.



Friction Clutch

Input shaft (A), coupled to the motor, turns friction drive gear (B). Friction drive gear (B) has a free fit on output shaft (C). However, pressure plates (E) are keyed to the output shaft. The "friction clutch assembly" of drive gear (B), friction washers (D) and pressure plates (E) is pressed against collar on output shaft (C) under pressure from spring (F) through washer (K) and sleeve (L). The friction between the gear and pressure plates, created by the spring pressure, causes the output shaft to rotate with the drive gear as a unit when the motor is running. This rotation will continue as long as the friction is strong enough to overcome all resistance to turning the output shaft. If the resistance however, becomes strong enough to overcome the friction, then slippage will occur between the gear (B) and pressure plates (E).

The amount of pressure exerted by spring (F) is adjustable. Therefore the friction can be adjusted to overcome the resistance of the heaviest normal load, yet slip if any greater resistance is encountered. This feature is intended to prevent damage to the mechanism in the event of a 'jam'.

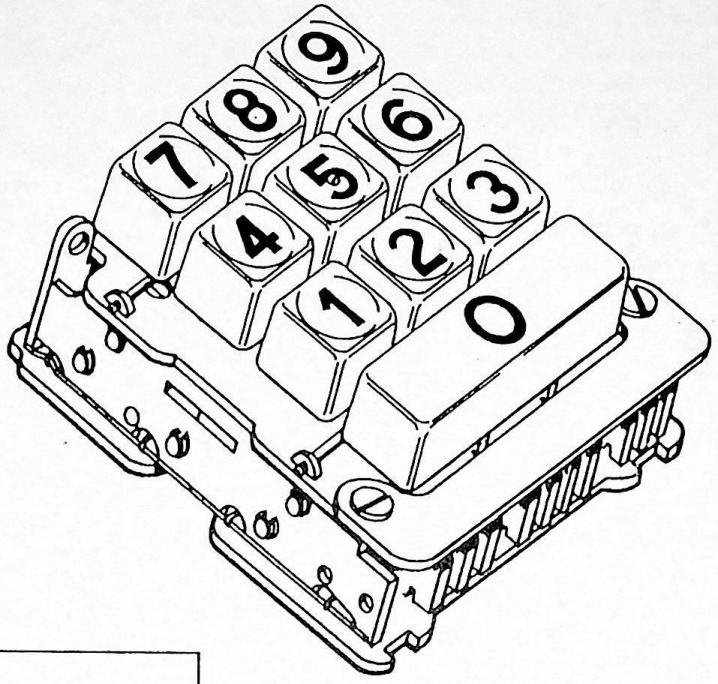
Thrust bearings are provided inside the gear box to receive the longitudinal thrust generated by the helical shape of the gears on the input and output shafts.

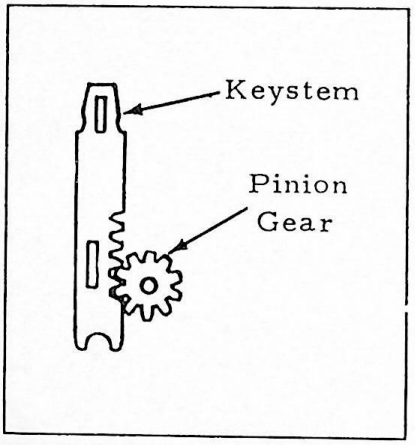
Adjustment

The friction spring (F) should exert enough pressure so that the friction clutch will not slip while taking a sub-total of 20 nines (9's) from the accumulator. To adjust the friction spring, set the machine on its back (base facing you), loosen the lock nut (H), turn the adjusting nut (G) clockwise for more pressure, counter-clockwise for less pressure, (do not forget to re-tighten the lock nut (H)). Check after adjusting the friction spring that the clutch slips (motor does not stall) when the main cam shaft is held from rotating by the hand crank.

SECTION III

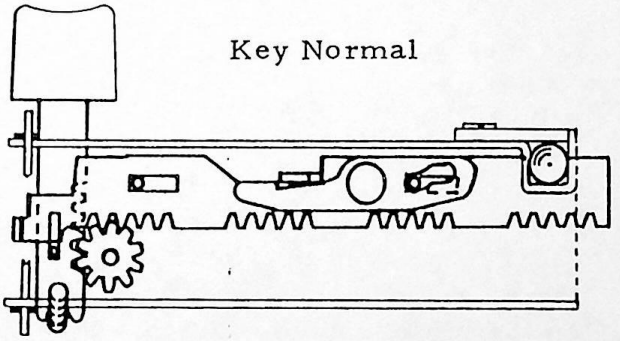
NUMERAL SET-UP MECHANISM



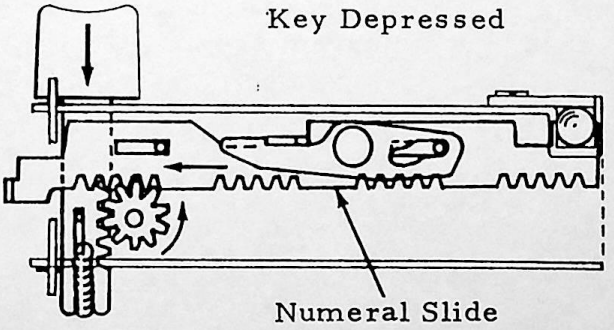


There are ten numeral keys (actually eleven keystems are used since the wide zero bar employs two keystems). Keystems are all alike. The keystems contain teeth, which engage pinion gears.

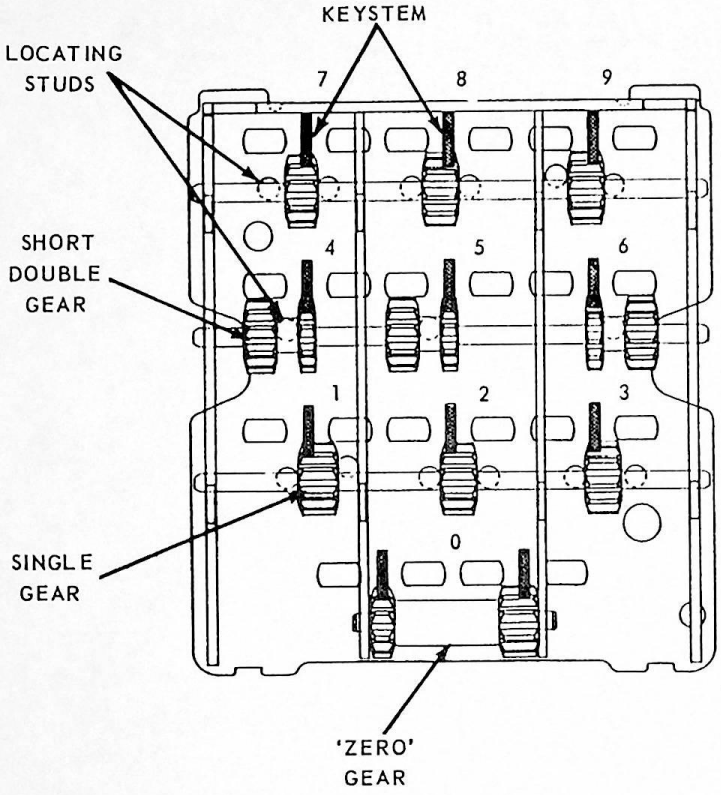
Drawings are Left Side Views



There are ten pinion gears. They serve to transfer the vertical movement imparted to the keystems into horizontal movement of a group of numeral slides.

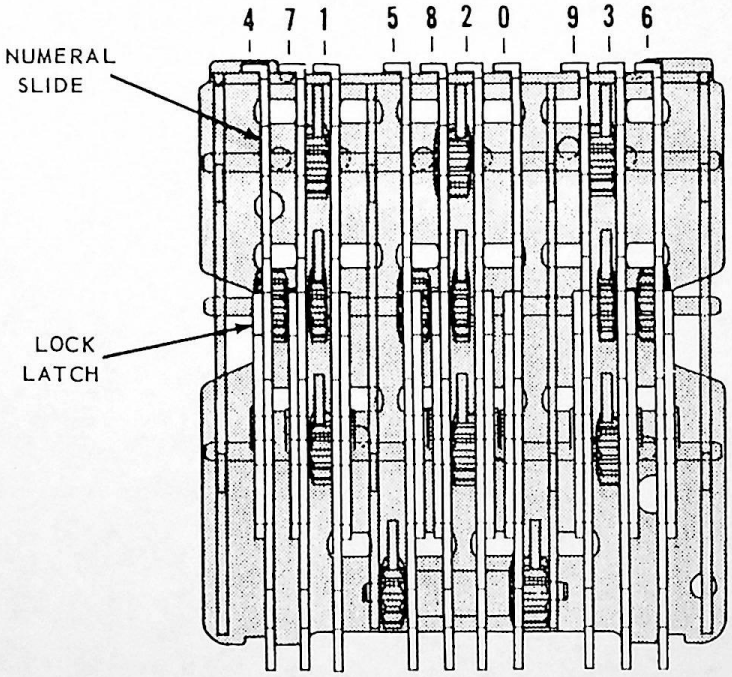


There are three types of pinion gears. The single gear is used where the keystem and the numeral slide it operates lie side by side (Nos. 1, 2, 3, 7, 8 and 9 keys). The short double gear is used when another slide falls between the keystem and the numeral slide that it operates (Nos. 4, 5, and 6 keys). The wide double gear is used with the twin zero keystems.



The single gears and short double gears are held in their proper lateral position by studs in the bottom plate.

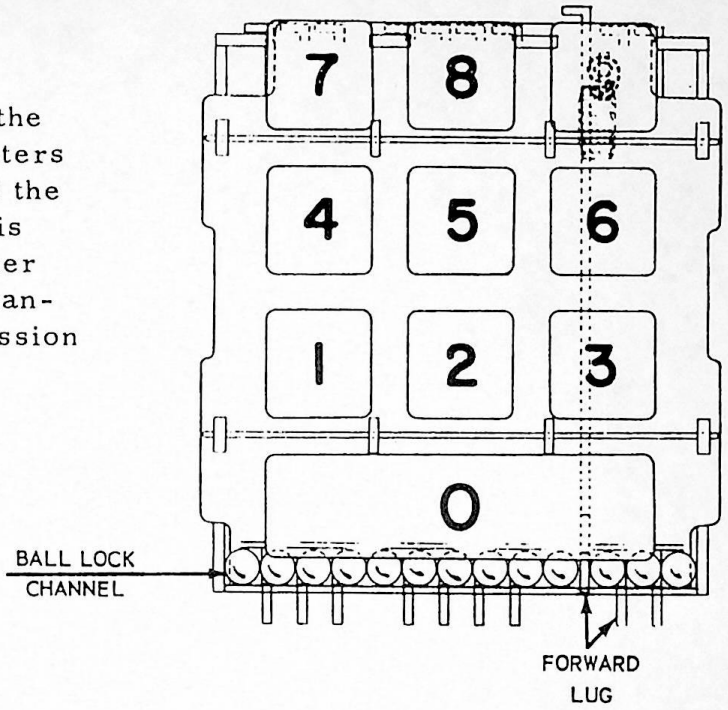
The diagram shows the correct arrangement of the gears.



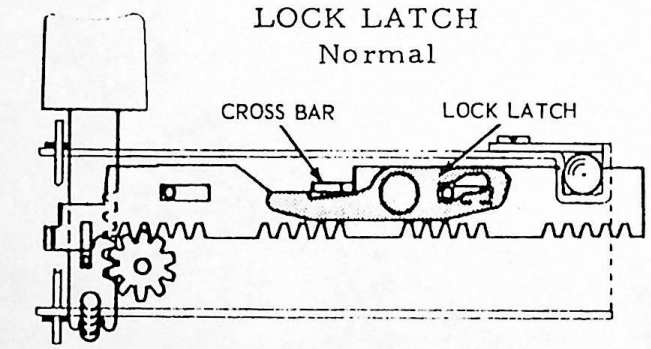
There are ten numeral slides. They all have lock latches. Five of the slides have their latches on the left side and the other five have their latches on the right. Slides with latches on the left are used in instances where the slide operating keystem is to the right and vice versa. The diagram shows the proper arrangement.

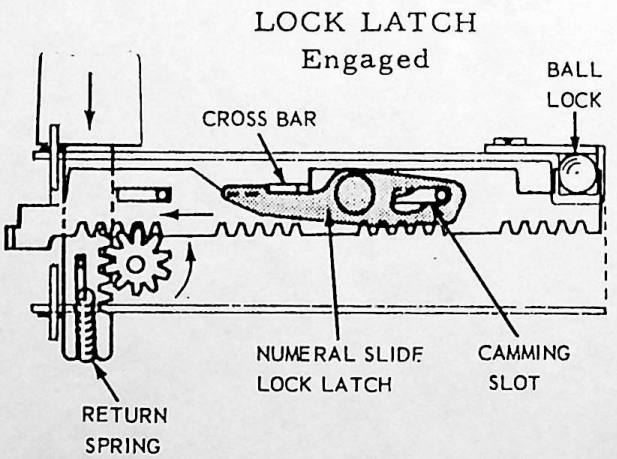
Numeral Key Ball Displacement Lock

When a numeral key is depressed, the forward lug of its numeral slide enters the ball lock channel, displacing all the available room in the channel. This prevents the forward lug of any other numeral slide from entering the channel and thereby prevents the depression of more than one key at a time.



Numeral Slide Lock Latch

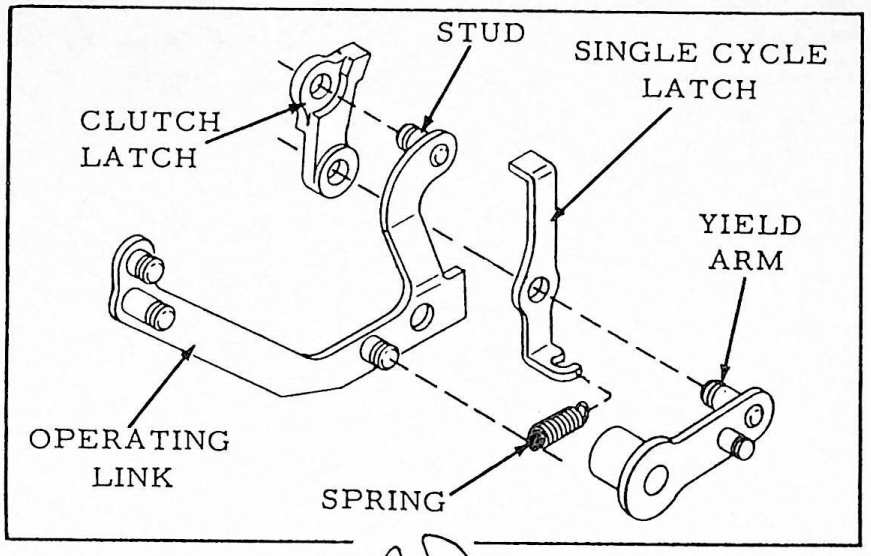


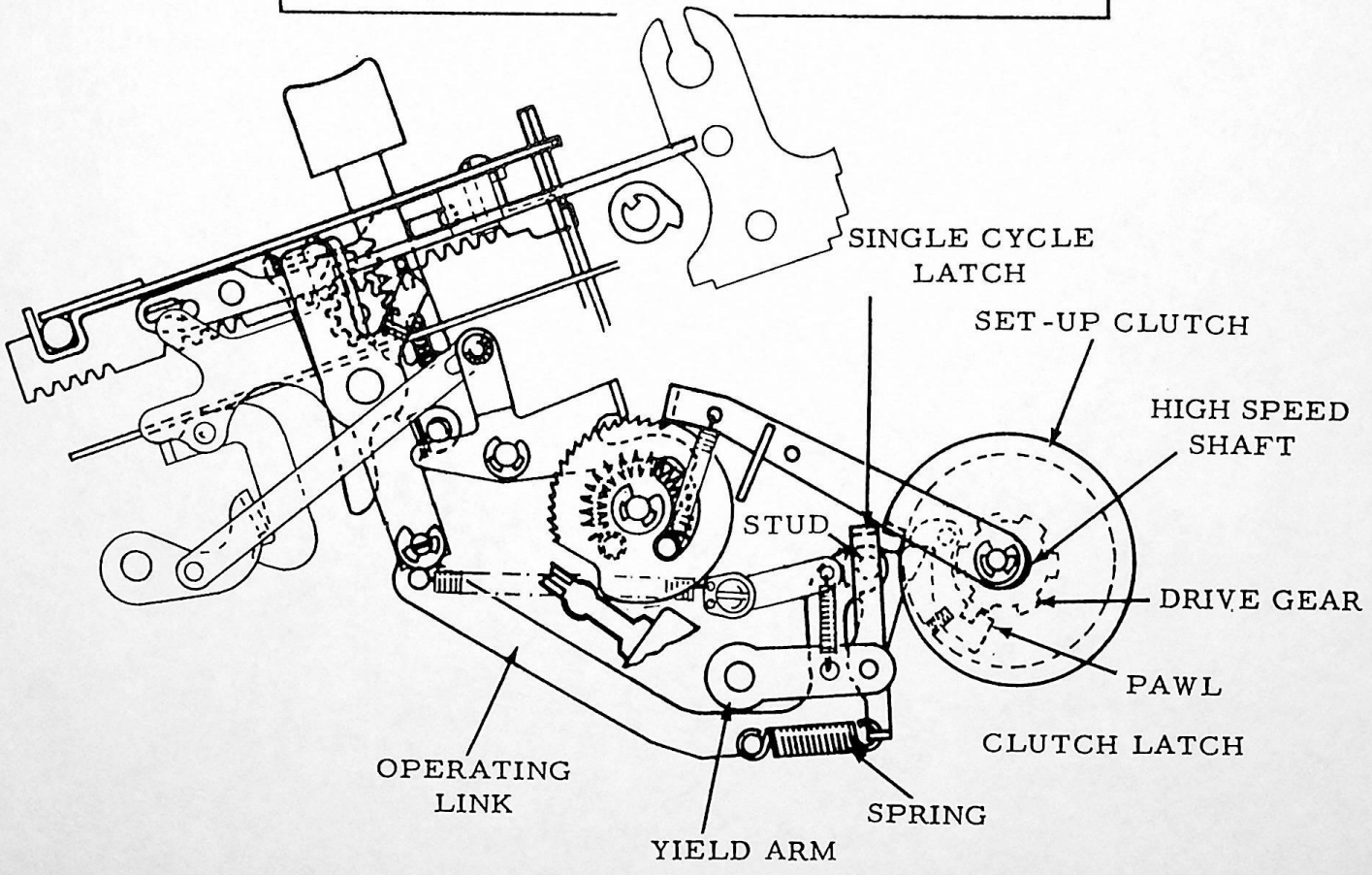


The purpose of the numeral slide lock latch is to prevent the depression of a numeral key until the set-up cycle initiated by the prior depression of another numeral key is completed. When a numeral key is depressed its numeral slide pushes a cross bar rearward. The return spring, under the keystem, immediately tries to raise the keystem and restore the numeral slide forward.

The lock latch of the numeral slide contains a camming slot, which causes the latch to engage the cross bar in the rearward position. This will keep the numeral slide to the rear and the ball lock displaced until the cross bar is allowed to return forward by the set-up clutch.

The set-up clutch is mounted on the high-speed shaft. In normal position, its pawl is held out of engagement with its drive gear by the clutch latch. The clutch latch is mounted, together with a single cycle latch, on a yield arm. An operating link is attached to the top of the clutch latch thru a stud. The same operating link is connected to the bottom of the single cycle latch by a spring.

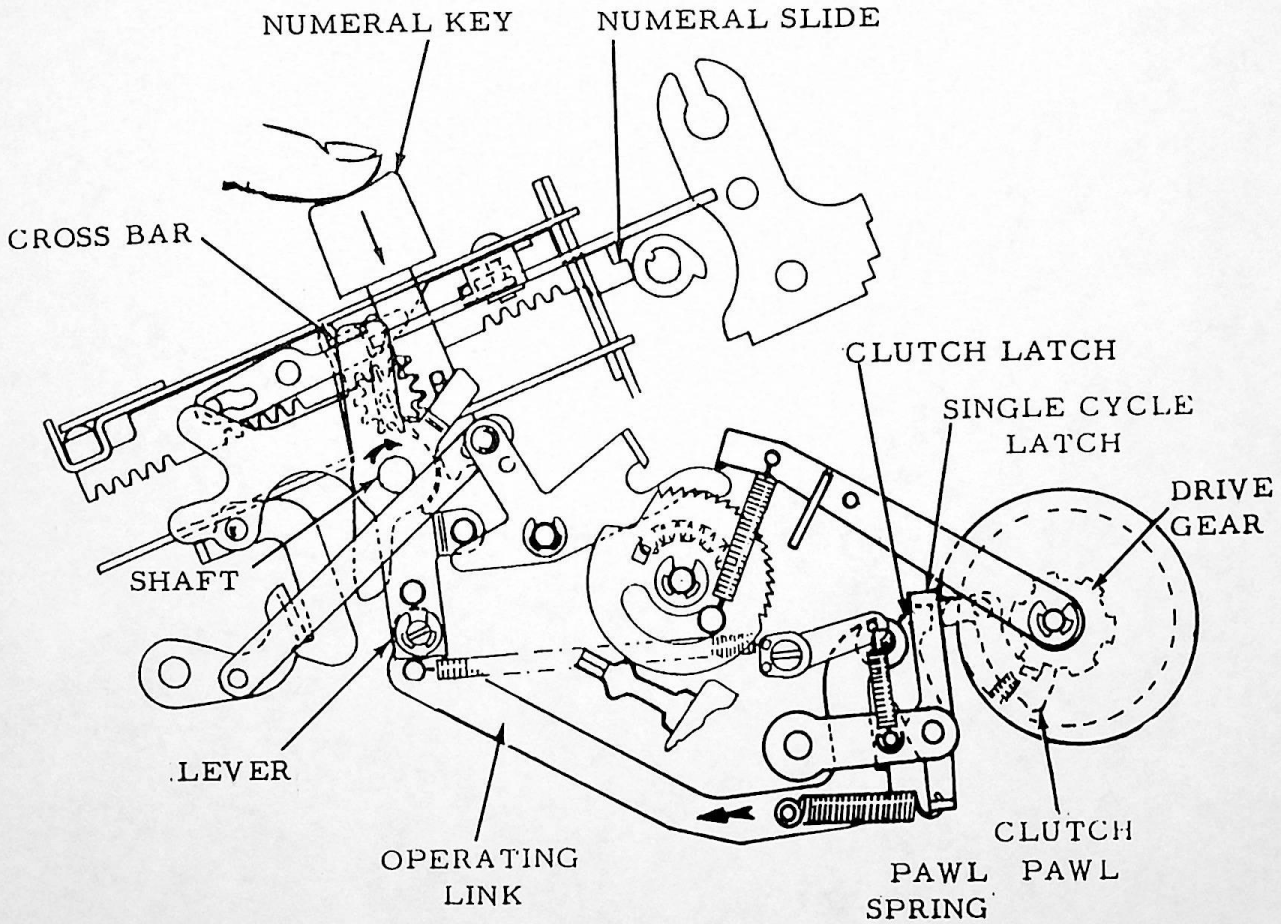




SET-UP CLUTCH - NORMAL POSITION

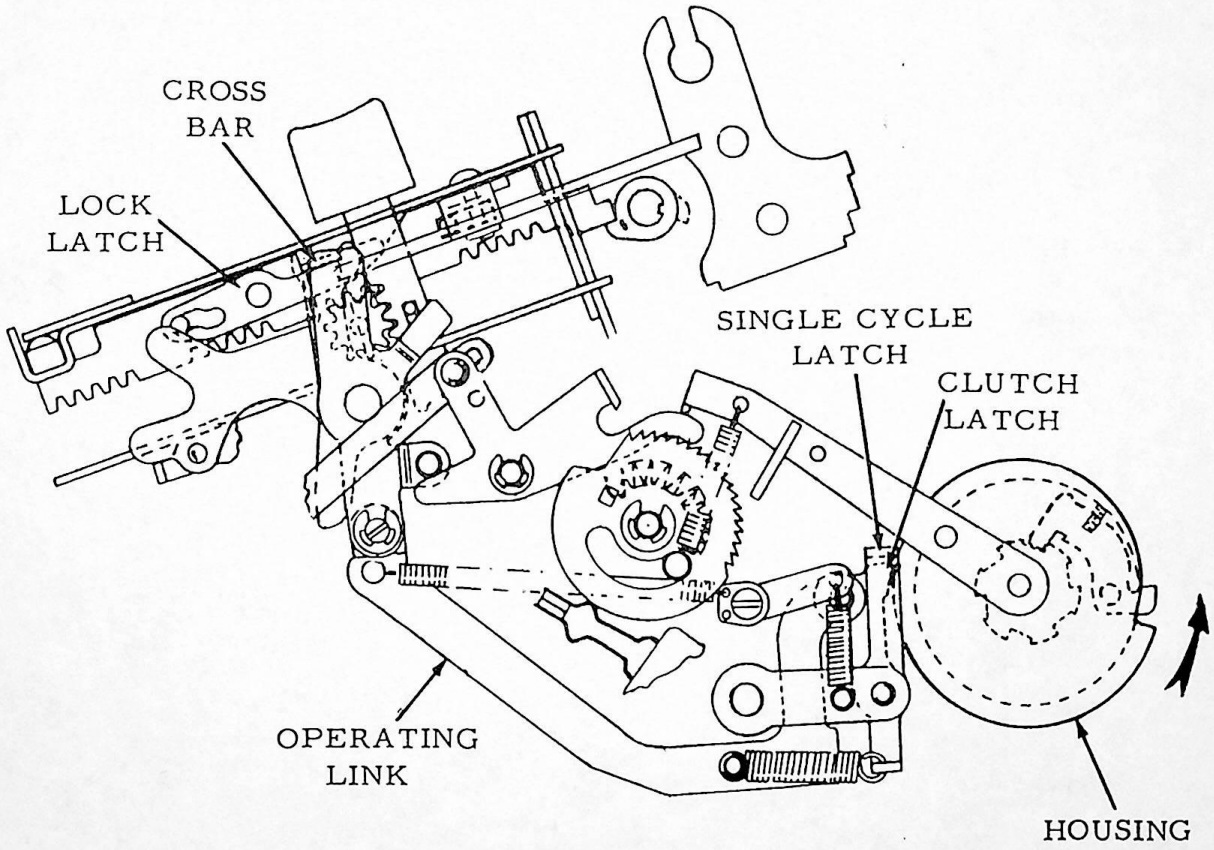
When a numeral key is depressed its numeral slide pushes the cross bar rearward. The cross bar is seated in notches on top of a pair of arms. The arms are pinned to a shaft. Therefore the movement of the cross bar causes the shaft to pivot. As the lever on the right end of the shaft pivots, it causes the switch to be closed as described previously. This same lever pulls the operating link for the clutch latch forward.

This forward movement of the operating link moves the top of the clutch latch and the top of the single cycle latch in opposite directions. The top of the clutch latch is pulled out of engagement with the clutch pawl. The pawl spring engages the pawl with the rotating clutch drive gear causing the clutch to cycle. The top of the single cycle latch is pivoted in against the housing of the clutch and its spring is loaded.

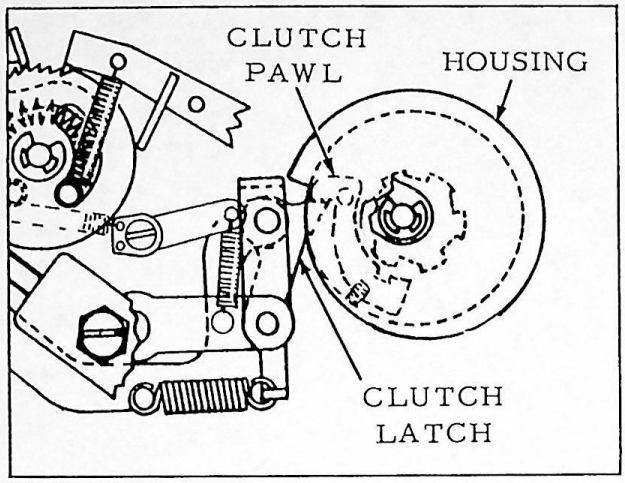


SET-UP CLUTCH - TRIPPED POSITION
Before start of Cycle

The clutch latch, like the single cycle latch, rides on the surface of the clutch housing. In this position it holds the operating link forward, keeping the shaft pivoted and the cross bar of the numeral keyboard rearward. This rearward position of the cross bar holds the numeral slide lock latch engaged, preventing depression of another numeral key until the cycle is almost completed.



SET-UP CLUTCH - $\frac{1}{2}$ CYCLE POSITION

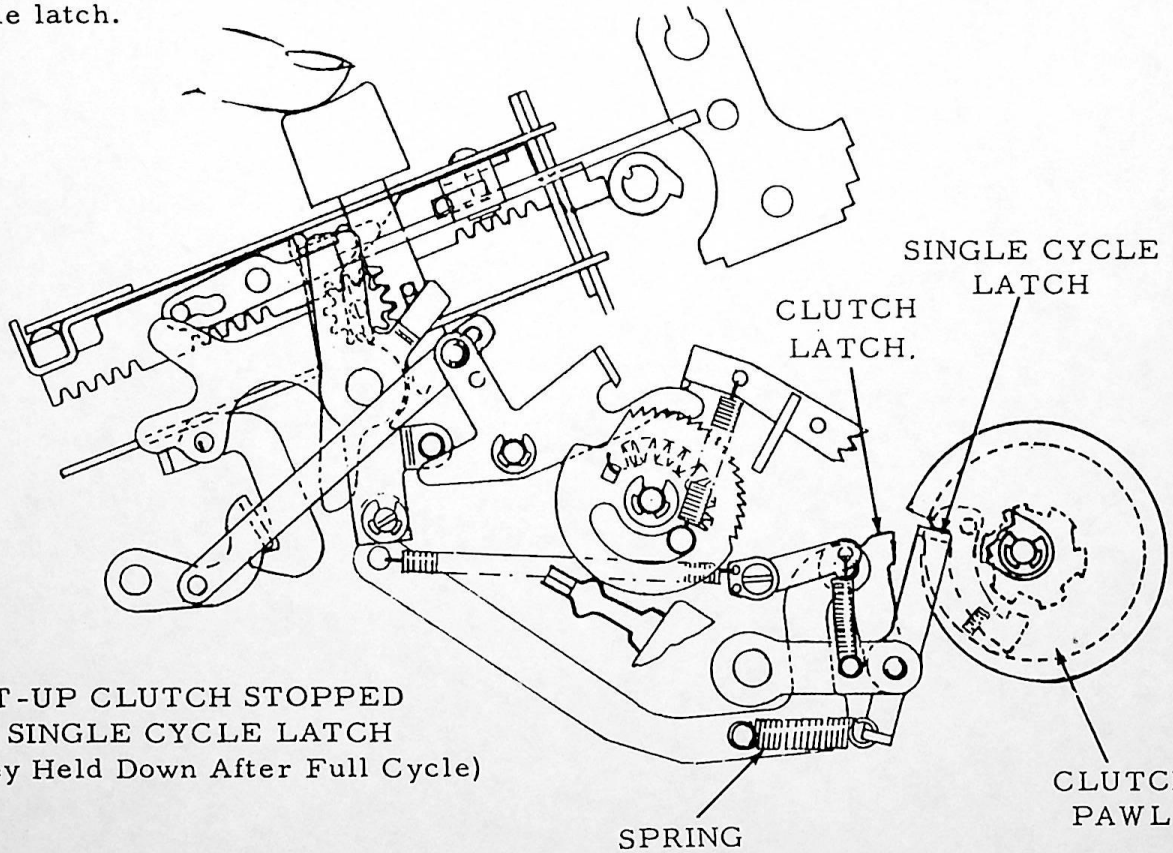


SET-UP CLUTCH STOPPED
ON CLUTCH LATCH
(Normal Position)

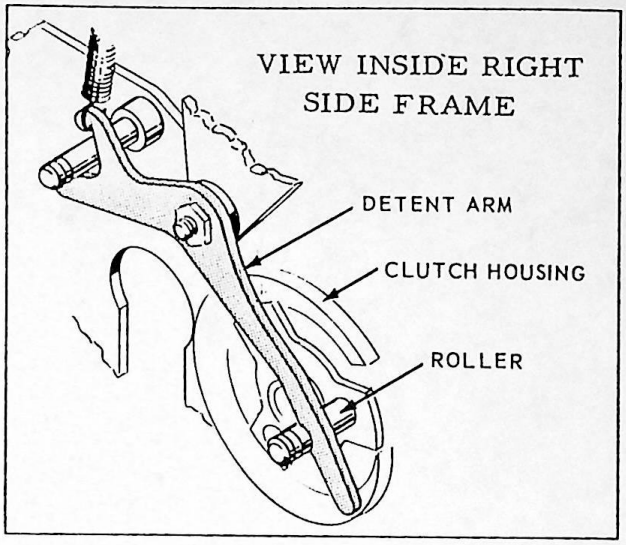
Near the end of the cycle the clutch latch is released by the housing and pulled into engagement with the clutch pawl (if the key is not held depressed) thereby stopping the cycle.

The single cycle latch comes into use when a key is held depressed. With the key held depressed, the clutch latch cannot move into engagement with the clutch pawl when released by the clutch housing. The depressed key, however, keeps the spring for the single cycle latch loaded so that this single cycle latch will be pulled into engagement with the clutch pawl when it is released by the clutch housing near the end of the cycle.

As the key is subsequently released, the clutch latch moves in under the single cycle latch as the single cycle latch is moving out of engagement with the clutch pawl. The pawl then is immediately engaged by the clutch latch as it is released by the single cycle latch.

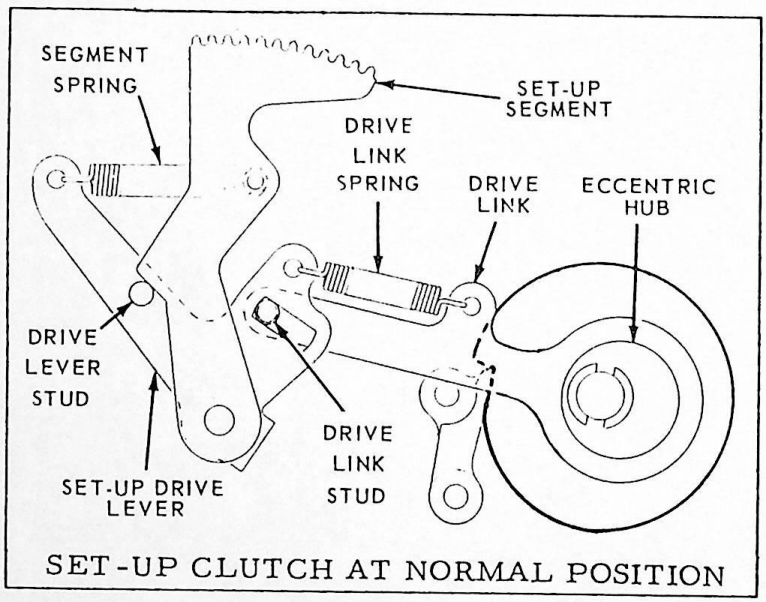


SET-UP CLUTCH STOPPED
ON SINGLE CYCLE LATCH
(Key Held Down After Full Cycle)



A stud projecting from the back of the set-up clutch carries a roller that engages a notch in a spring loaded detent arm. This arrangement provides a fixed "home" position for the clutch housing thereby preventing it from backing up and causing "chatter".

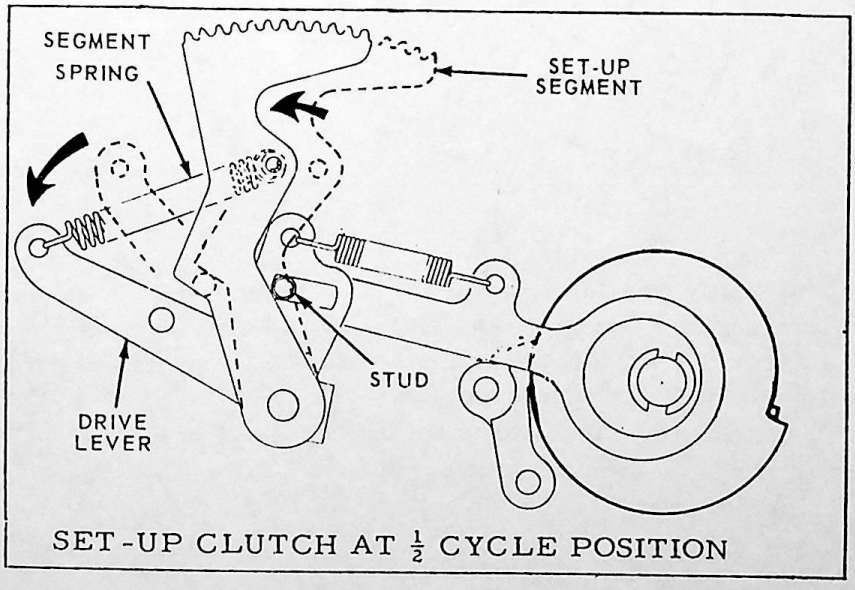
An eccentric hub, moulded in the outer face of the clutch housing, carries the drive link for numeral set-up. The drive link is moved first forward then rearward, on each cycle of the set-up clutch. The drive link has a stud that is engaged in a slot of the set-up drive lever. The drive link is also connected to the drive lever by the drive link spring. This connection provides a yielding feature in the event of a jam on the second half of the numeral set-up cycle.



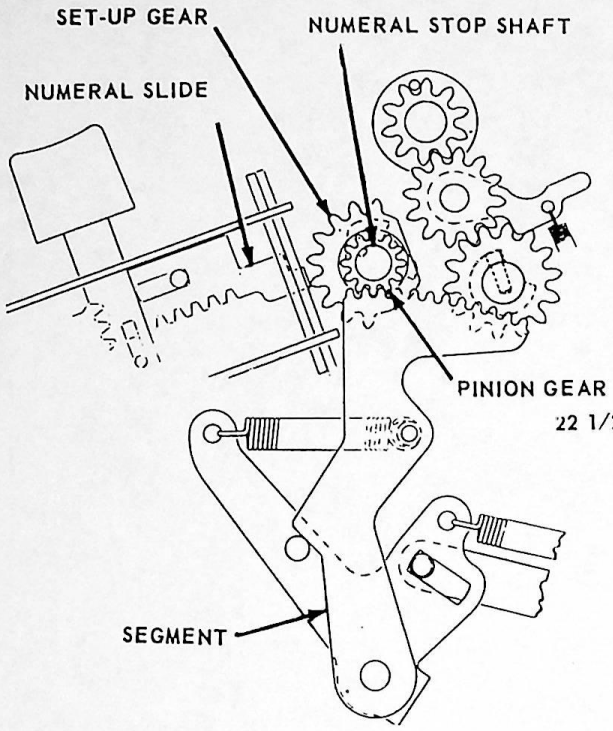
SET-UP CLUTCH AT NORMAL POSITION

The drive lever is connected to the set-up segment by a similar yielding connection. The set-up segment is normally held against a stud in the drive lever by the segment spring.

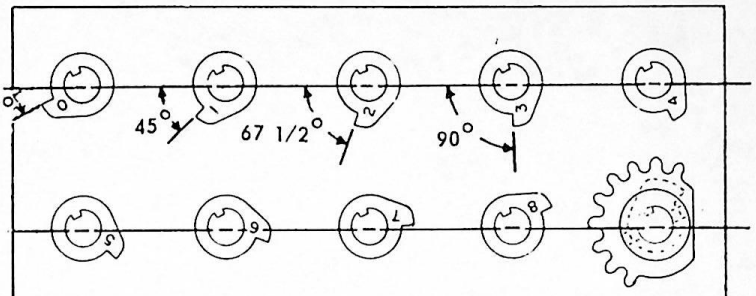
On a set-up cycle the drive lever carries the segment forward until the segment is stopped at the selected position. The drive lever continues to its full stroke at the $\frac{1}{2}$ cycle position of the clutch as the segment spring yields.



SET-UP CLUTCH AT $\frac{1}{2}$ CYCLE POSITION



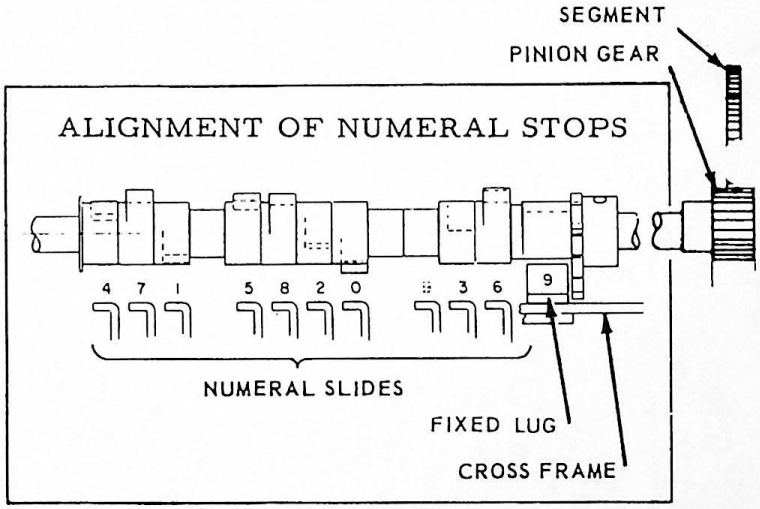
The segment is engaged with a pinion gear on the end of the numeral stop shaft. In addition to the pinion gear, the numeral stop shaft contains a nine tooth set-up gear and a group of stops.

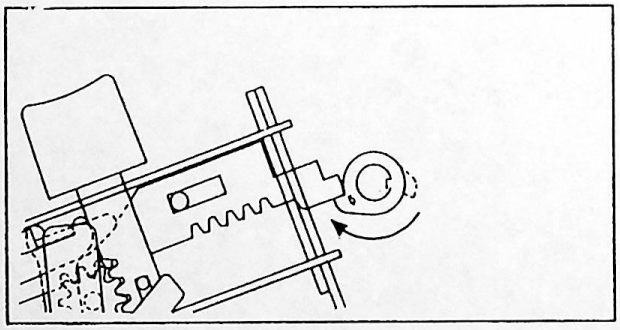


NUMERAL STOPS AND SET-UP GEAR
(Numbers are moulded on sides of stops)

The stops are aligned with the rear lugs of the keyboard numeral slides.

When a numeral key is depressed, its slide projects from the rear of the keyboard into the path of its associated stop.* The segment is rocked, rotating the stop shaft until the stop contacts the selected numeral slide.





*The only exception to this is the slide for the number '9' key. This slide is not contacted by the '9' stop.... The '9' stop is moulded as a part of the set-up gear hub and it contacts a fixed lug on the back of the cross frame.

The stops are positioned at $22\frac{1}{2}°$ intervals around the stop shaft and arranged so that the stop for each successively higher numbered key permits the shaft to be rotated $22\frac{1}{2}°$ more than the stop for the next lower numbered key.

The teeth of the set-up gear are also $22\frac{1}{2}°$ apart. Therefore, for each successively higher numbered key depressed, the set-up gear will be rotated an additional tooth.

Adjustment

Adjustment is made with motor cord removed....Operate machine with hand crank.

Depress any numeral key (except '9') and cycle set-up mechanism until its numeral stop limits on the lug of its numeral slide. Adjust eccentric to obtain full hold of thickness of lug on stop (A).

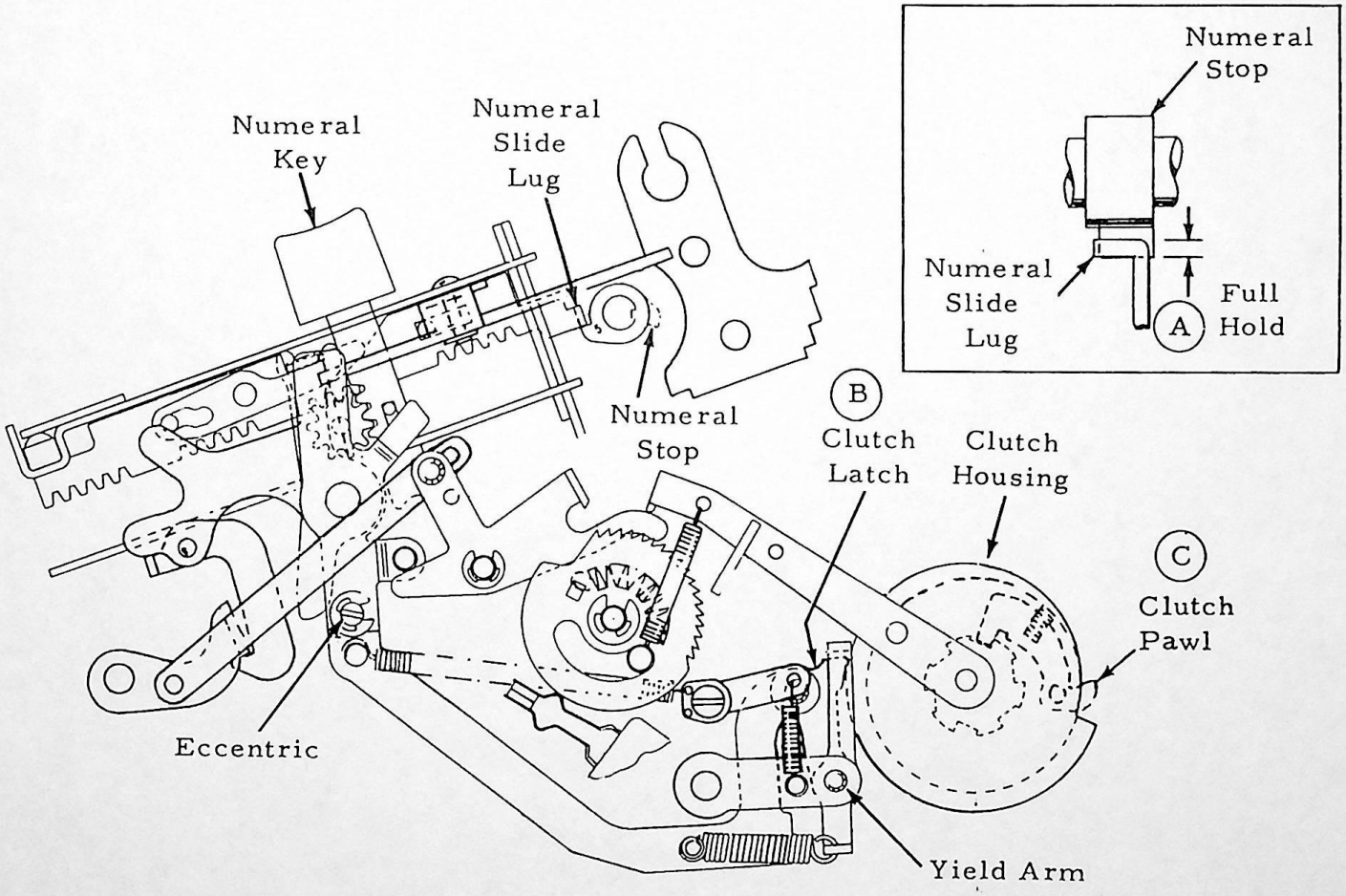
After making this adjustment check the following:

A. Check for same full hold on all other stops.

B. Check for cramping of clutch latch on clutch housing....Eccentric adjustment is too tight if yield arm yields during cycle.

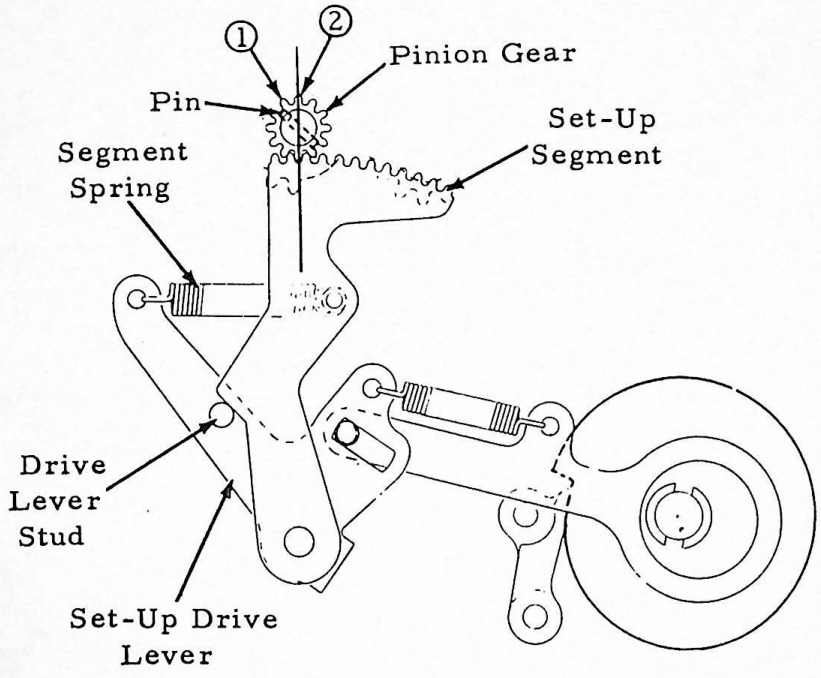
C. Check that clutch pawl is fully released upon slow depression of all numeral keys.

Make minor refinements in eccentric adjustment if necessitated by above checks.

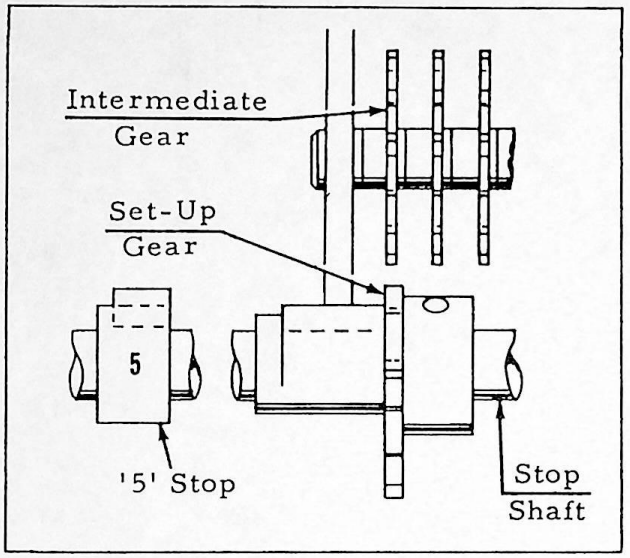


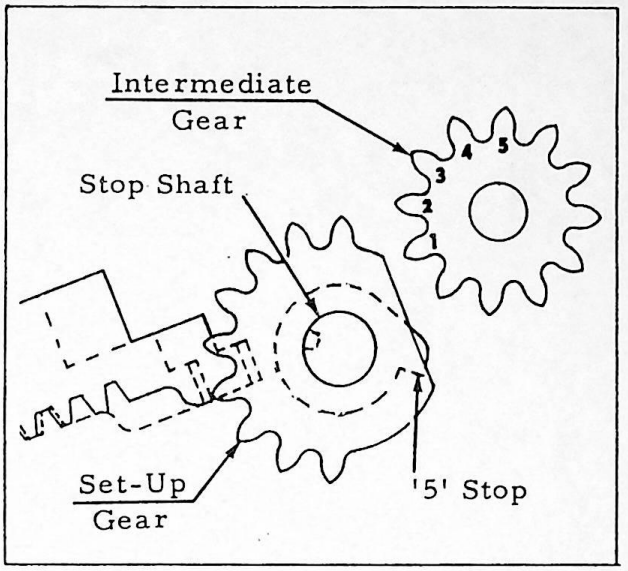
TIMING OF PINION GEAR TO SEGMENT

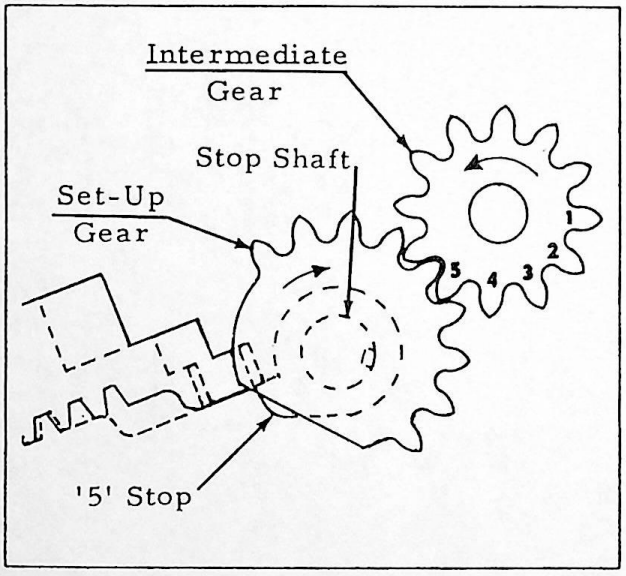
With the set-up clutch in normal position and set-up segment held against drive lever stud by segment spring, count two teeth clockwise from the pin in the hub of the pinion gear. This second tooth of the pinion gear should be on a vertical center-line.



The set-up gear is aligned to engage an intermediate gear of the set-up carriage on the first half of the set-up clutch cycle...

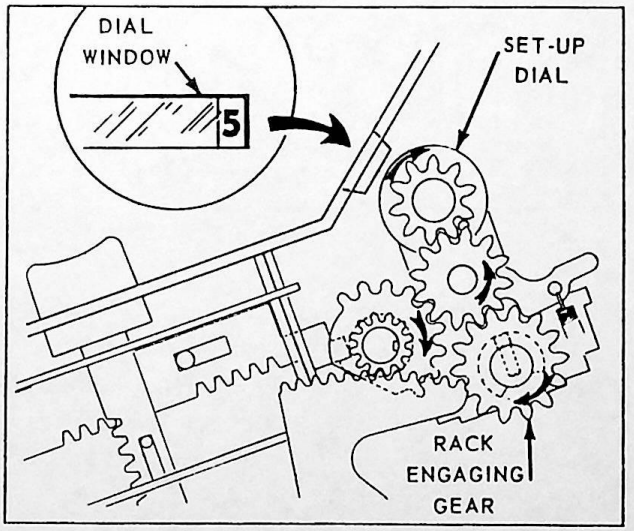


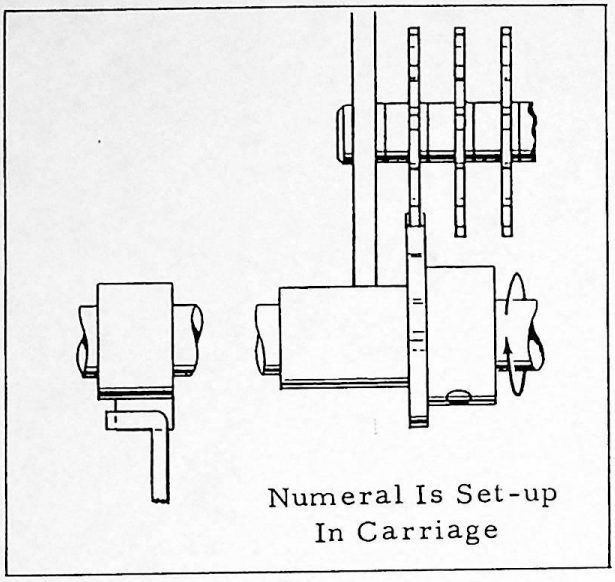




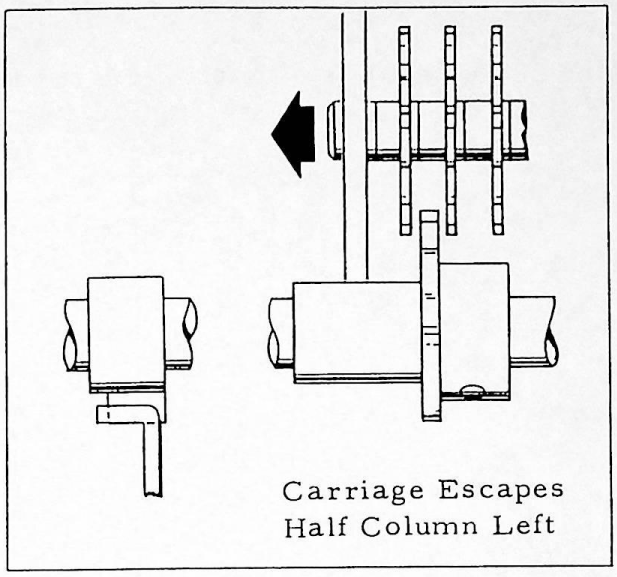
...If then, the '5' numeral key is depressed---it's associated stop permits the stop shaft to rotate until the aligned intermediate gear of the set-up carriage has been displaced five teeth by the set-up gear.

This displacement of the set-up carriage intermediate gear turns the set-up dial from '0' to '5' (at the dial window) and also rotates the rack engaging gear five teeth away from its zero stop position.



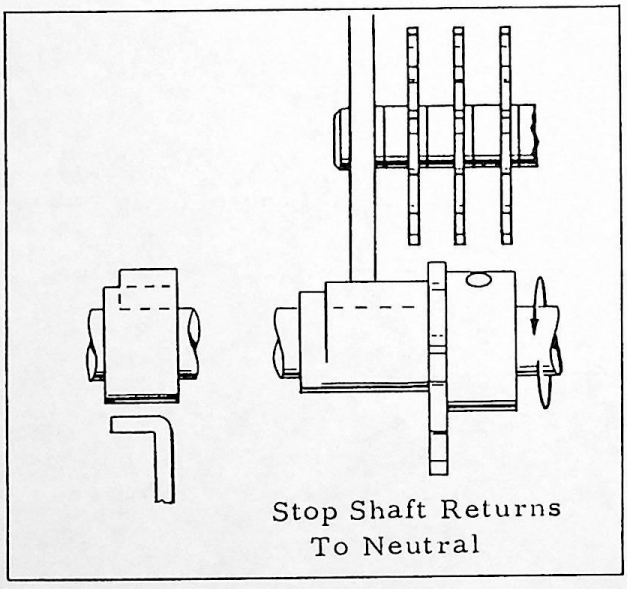


Numeral Is Set-up
In Carriage

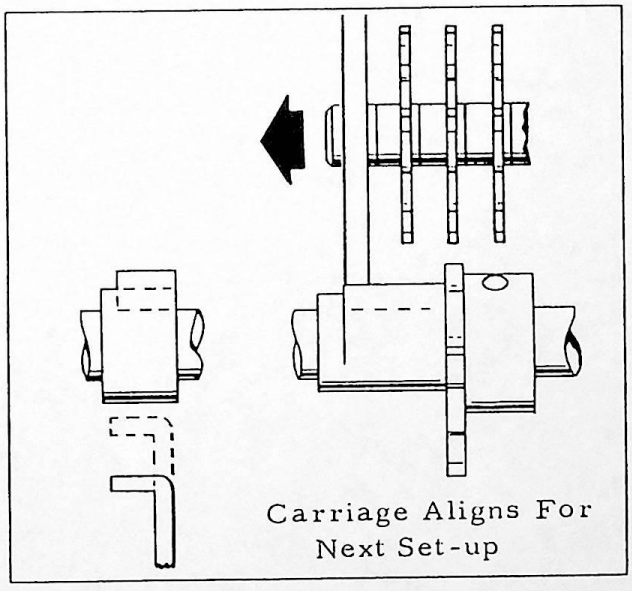


Carriage Escapes
Half Column Left

As the set-up clutch nears the half cycle position, the set-up carriage escapes a half column to the left. This disengages the intermediate gear from the set-up gear.



Stop Shaft Returns
To Neutral



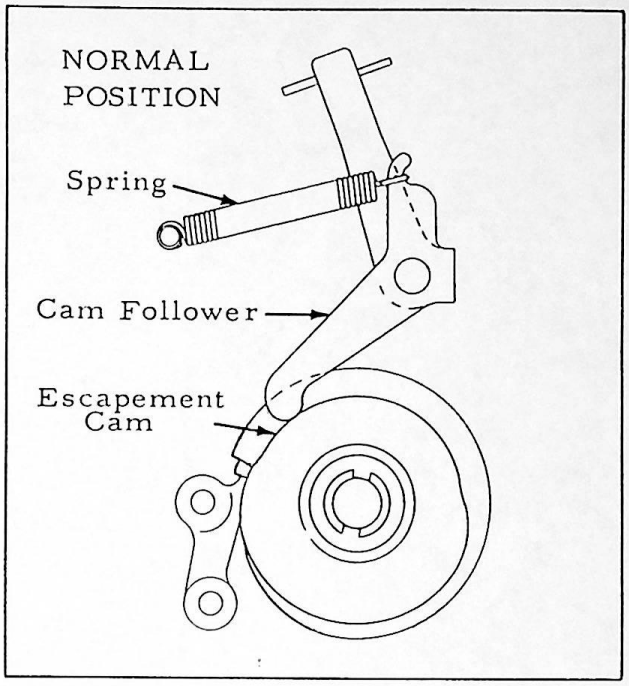
Carriage Aligns For
Next Set-up

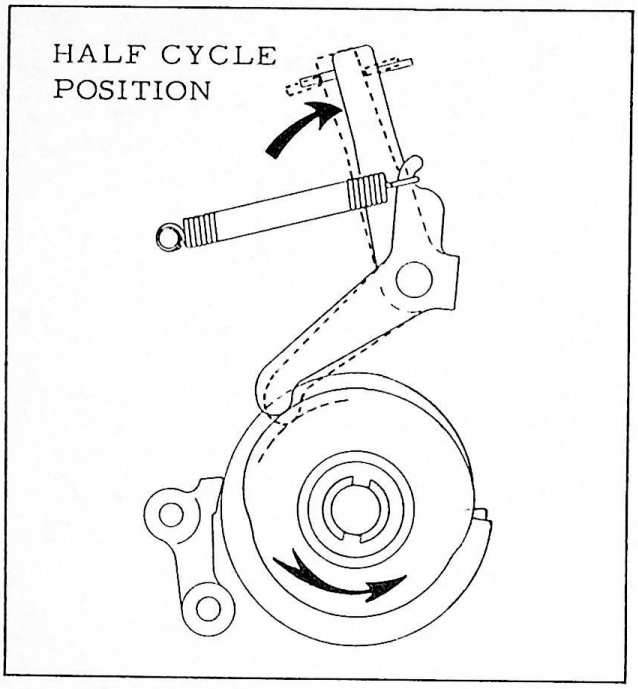
The set-up gear and stop shaft rotate back to normal position while the set-up dial and its gears remain detented in the '5' position. This restoring of the stop shaft occurs on the second half of the set-up clutch cycle.

Near the end of the cycle, the set-up carriage escapes another half column to the left. This aligns the intermediate gear of the next column in the set-up carriage with the set-up gear.

The escapement of the set-up carriage to the left during numeral entry is controlled by an escapement cam. This escapement cam is keyed to and cycles with the set-up clutch housing.

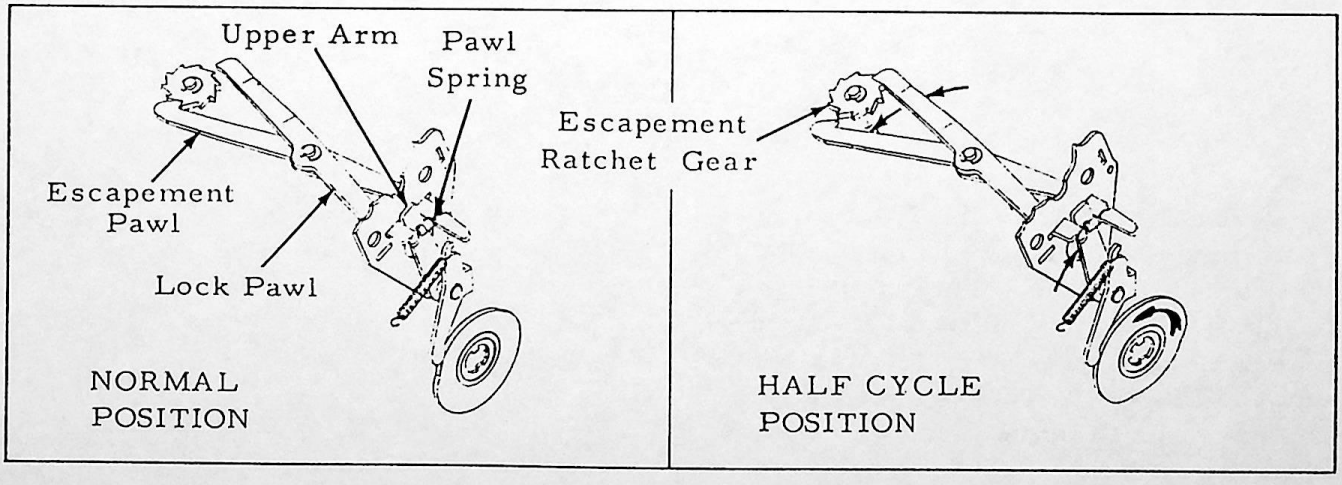
A cam follower is held against the escapement cam by a spring.

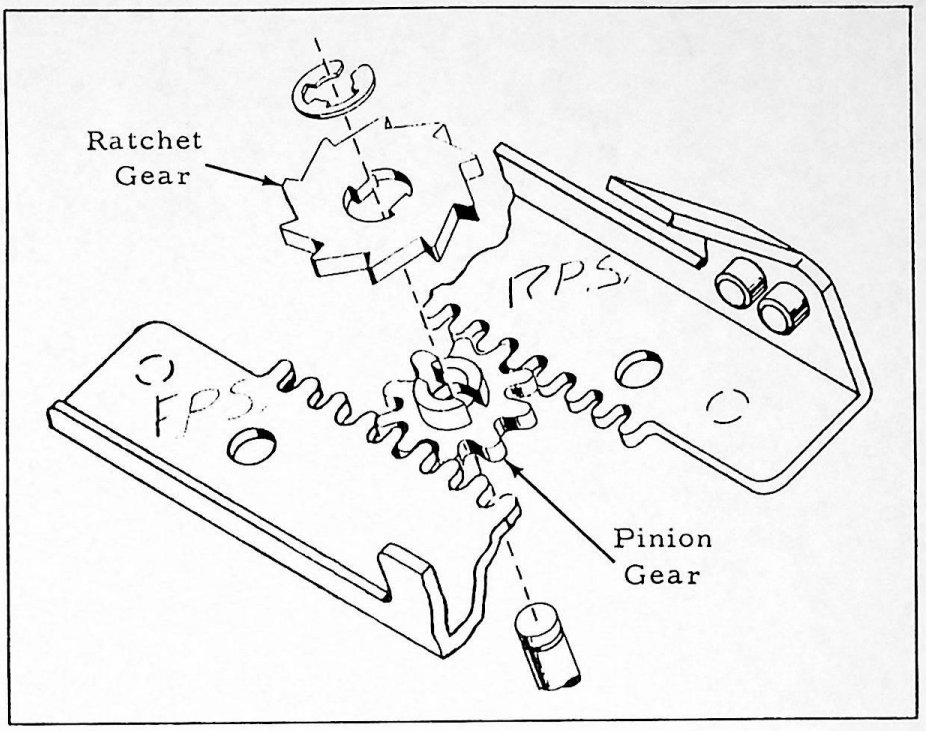




The cam follower is rocked rearward when the set-up clutch approaches the half cycle point---then forward again as the clutch completes a full cycle.

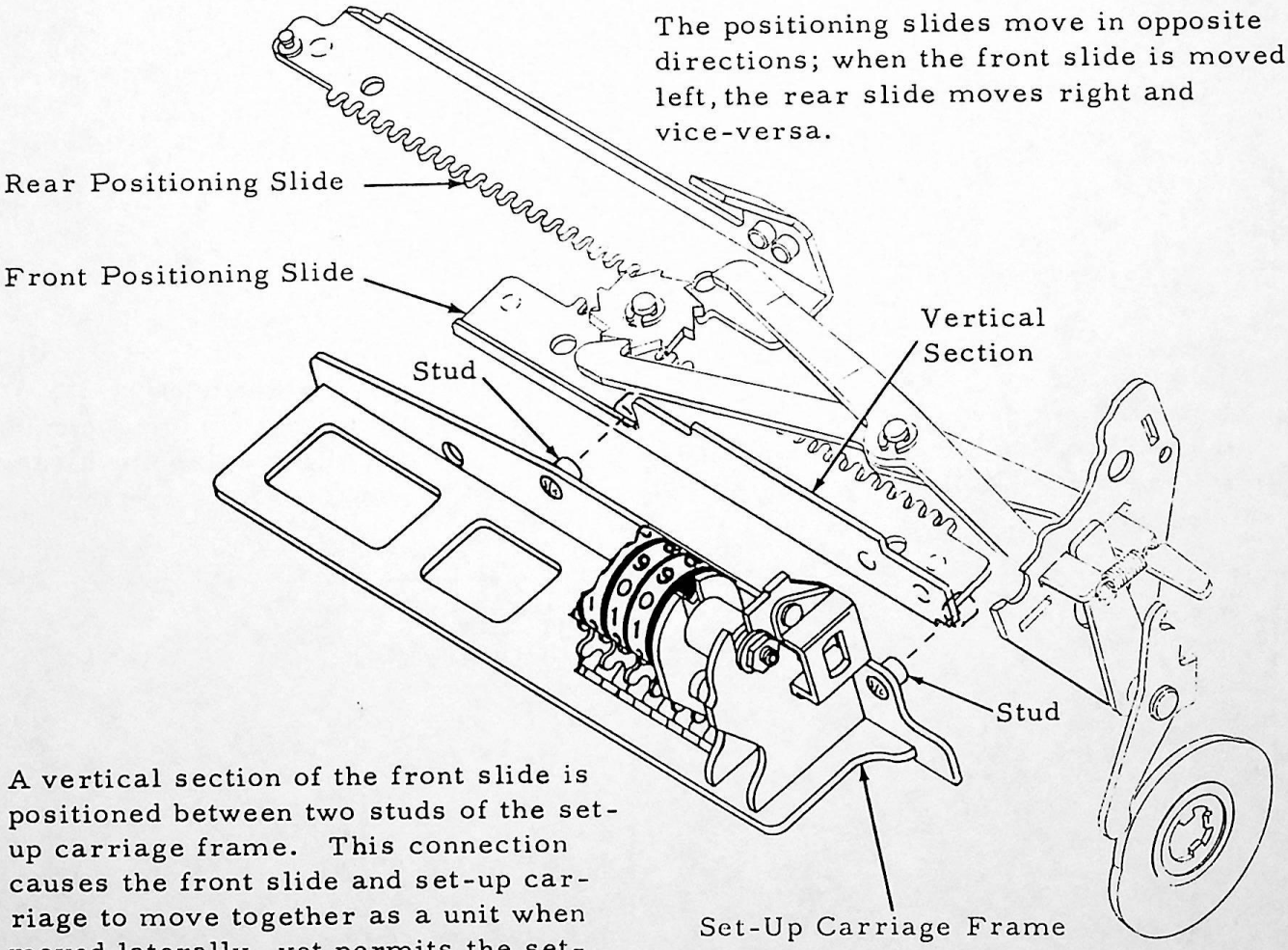
The upper arm of the cam follower is positioned between an escapement pawl and lock pawl. Both pawls are held against the cam follower arm by a common spring. Both pawls also have a common pivot point and the rocking of the escapement cam follower causes the left ends of the pawls to alternately engage the escapement ratchet gear.





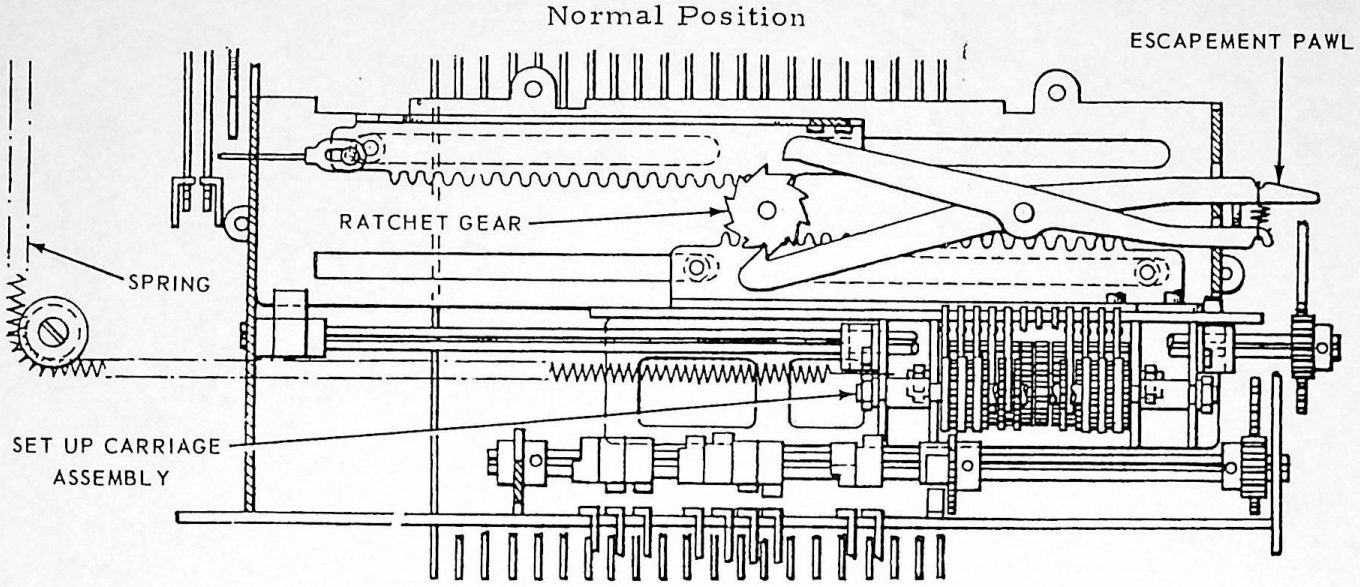
The escapement ratchet gear is attached to a pinion gear. The pinion gear is meshed, front and rear, with the two set-up carriage positioning slides.

The positioning slides move in opposite directions; when the front slide is moved left, the rear slide moves right and vice-versa.



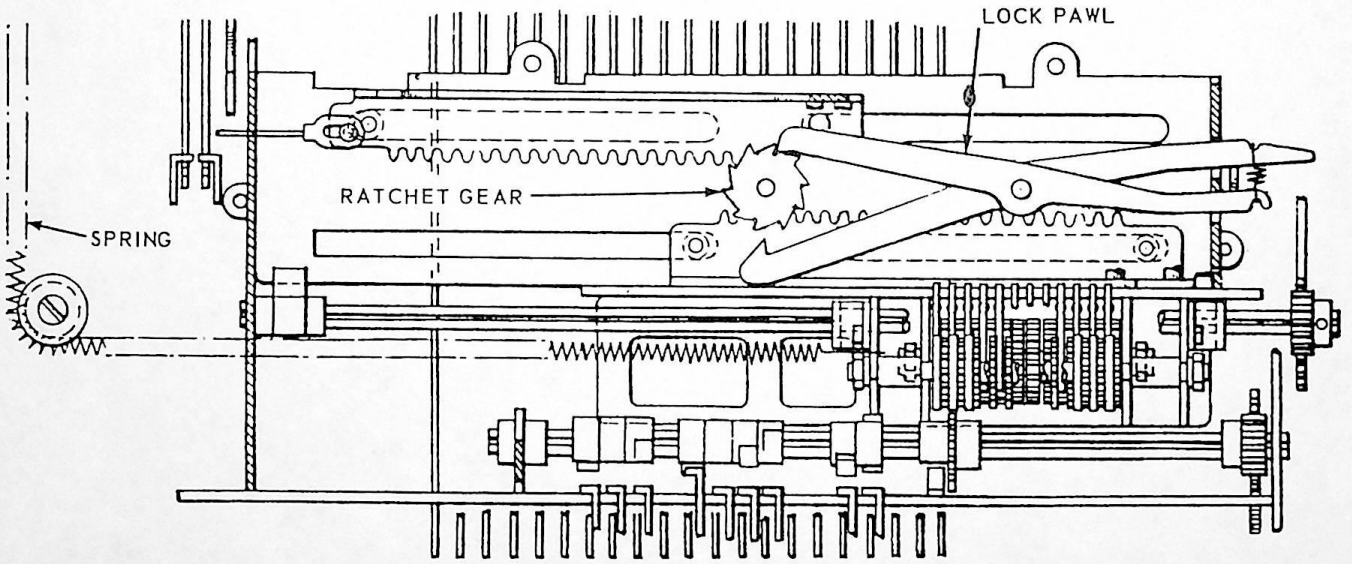
A vertical section of the front slide is positioned between two studs of the set-up carriage frame. This connection causes the front slide and set-up carriage to move together as a unit when moved laterally, yet permits the set-up carriage to move vertically without moving the slide.

Normal Position



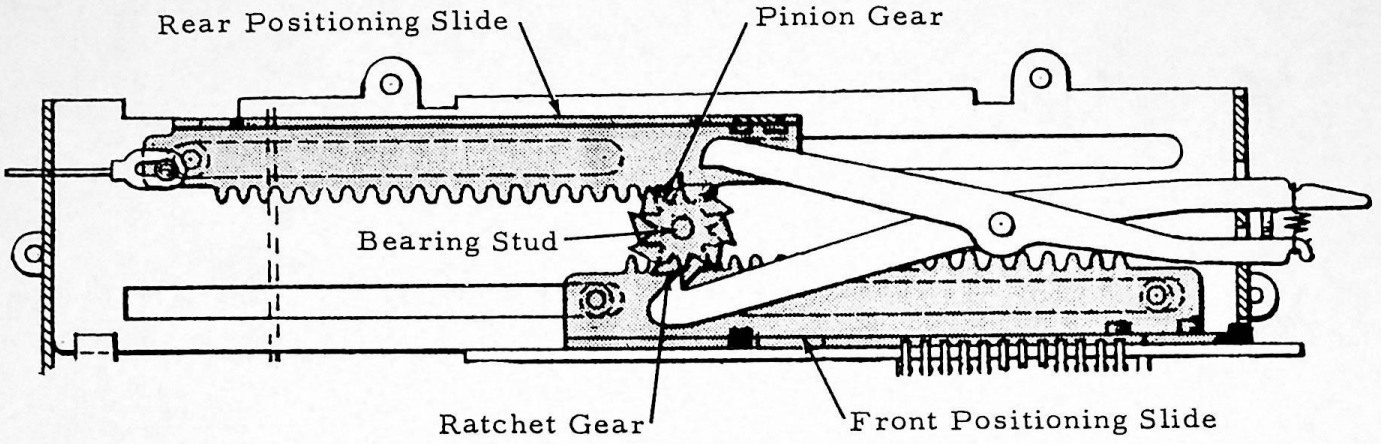
A long spring is attached to the left side of the set-up carriage frame and is constantly trying to pull the set-up carriage to the left. The set-up carriage is prevented from moving left by the engagement of the escapement pawl with the escapement ratchet gear.

Half Cycle Position



The rocking of the escapement cam follower, as the set-up clutch approaches half cycle, moves the escapement pawl out of engagement with the ratchet gear and the lock pawl into the path of the ratchet gear. The set-up carriage is pulled a half column to the left---rotating the ratchet gear a half tooth, at which point the ratchet gear is engaged by the lock pawl.... The pawl movement is then reversed by the cam follower as the set-up clutch completes the full cycle---and the set-up carriage is pulled a half column further left.

Timing of the Set-up Carriage Positioning Slides



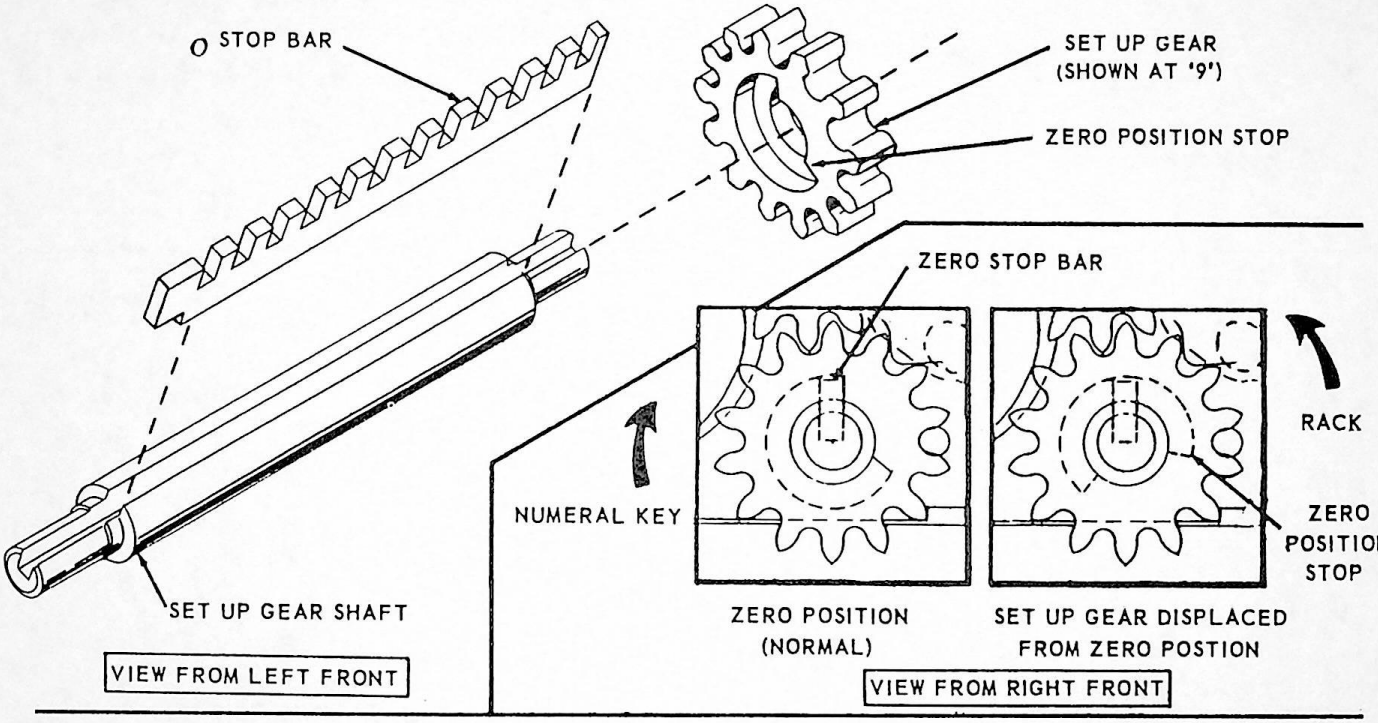
With the set-up carriage rear positioning slide to the extreme left and the set-up carriage front positioning slide to the extreme right, place the pinion gear on the bearing stud, coupling the two racks together. Then assemble the ratchet gear to the pinion gear and secure with retainer #60913.

NOTES

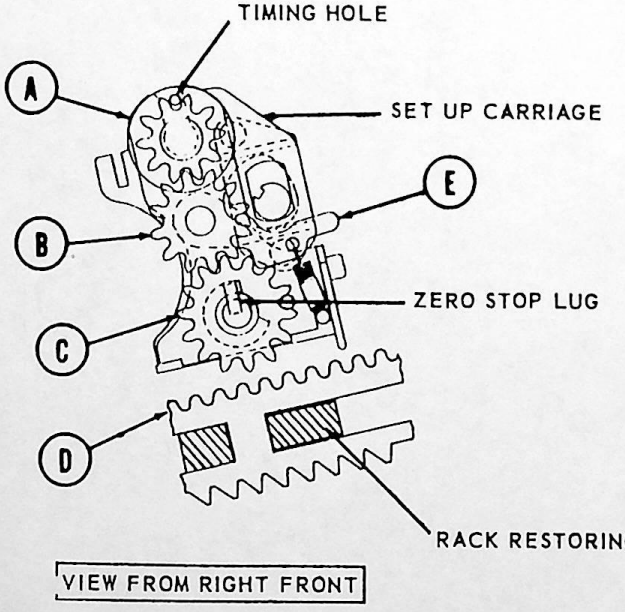
NOTE: The lower row of gears in the set-up carriage, which have previously been referred to as the "rack engaging gears" will be referred to as the "set-up gears" in the following text.

Set-Up Gear Shaft

The numeral key displaces the set-up gear in a clockwise direction. The printing rack in its rearward movement (spring tension) rotates the set-up gear back until the rack is stopped by the lug on the stop bar. (Zero position).



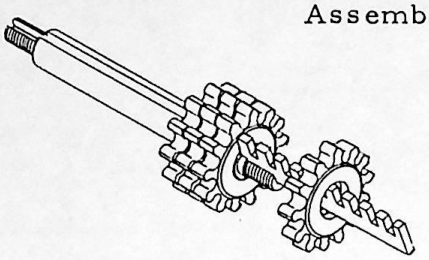
Set-Up Gears



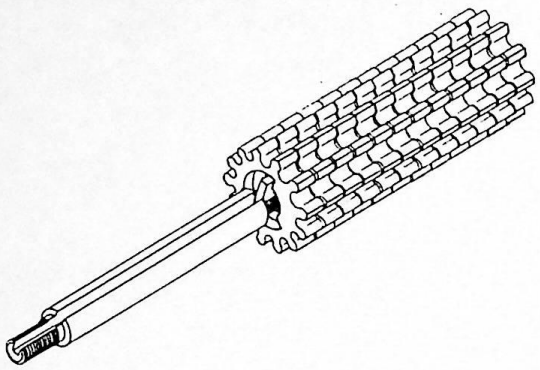
Set-up gear (C) is displaced from its zero (neutral) position by intermediate gear (B), and returned to zero position by the printing rack (D). (C) will also return to the set-up (displaced from zero) position, if (C) remains in mesh on both strokes of (D).

Detent pawl (E) engages the teeth of (C) detenting (B) and reading dial gear (A). (E) disengages from teeth of (C) when engaged with teeth of (D).

Assembling the Set-Up Gears



Place the left hand stop lug (wide lug) into the keyway, slip the set-up gear as shown on the stop bar and feed gear and bar onto the shaft. Repeat this for the twelve gears.



The gears may be assembled to the stop bar and then fed into the keyway of the set-up shaft; assemble whichever way is the easiest, except the internal stop cam must be to the left with the wide stop lug to the left.

Timing of the Set-Up Carriage Dial Gears

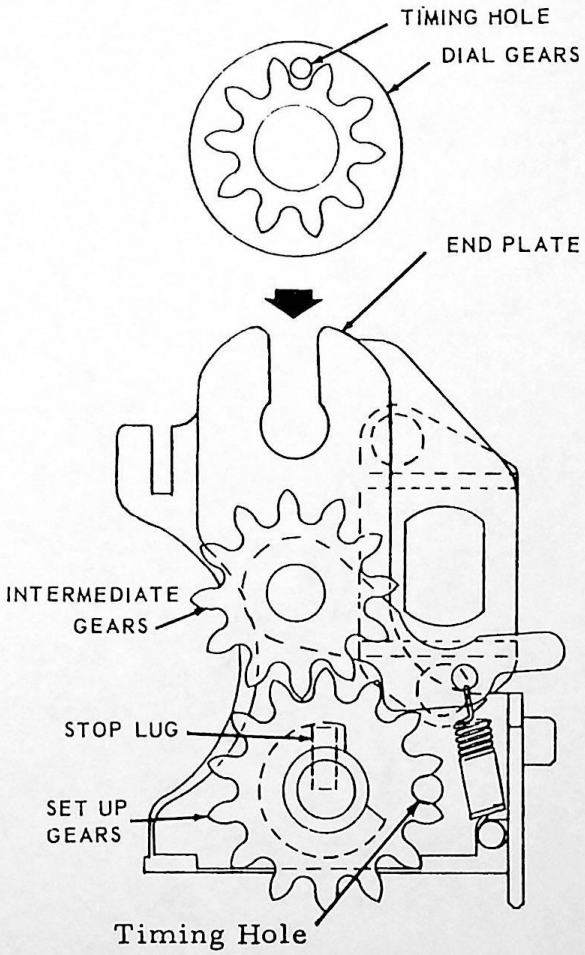
With the set-up gears and the intermediate gears assembled to the set-up carriage frame:

(1) Rotate the set-up gears counter-clockwise until they limit on the stop lug.

(2) Insert a 2" length of 1/32 rod through the timing hole of the dial gears, allowing an equal amount of the rod to extend on both ends of the dial gears.

(3) With set-up gears turned to zero position, insert a rod thru timing holes in carriage end plates.

(4) With the dial timing rod in the center of the slots in the end plates, mesh the dial gears with the intermediate gears.



SECTION IV

ADDING MACHINE MECHANISM

The following Program Bails drive the listed Program Slides:

Clear Program Bail:

#4 Set-up carriage engagement (and locks numeral KB and decimal key).

#7 Set-up carriage return (and moves the decimal bail to the right).

#12 Non-print/non-space.

#14 Hold-up latch disabling.

Non-Add:

#4 Set-up carriage engagement (and locks numeral KB and decimal key).

#7 Set-up carriage return (and moves the decimal bail to the right).

#14 Hold-up latch disabling.

4 Non-add symbol slide full right (controls #1 symbol rack).

Plus:

#2 Accumulator plus and minus engagement.

#5 Set-up carriage escapement (and drives #4 to the right).

#4 Set-up carriage engagement (and locks numeral KB and decimal key).

#7 Set-up carriage return (and moves the decimal bail to the right).

Minus:

#2 Accumulator plus and minus engagement.

#5 Set-up carriage escapement (and drives #4 to the right).

#7 Set-up carriage return (and moves the decimal bail to the right).

#3 Minus accumulator program slide.

#8 Multiply/minus symbol slide full right (controls #2 Symbol rack).

Repeat and Square:

#11 Total/sub-total cam program slide.

Total:

#6 Accumulator total.

#14 Hold-up latch disabling.

#2 &#3 Neg total/total symbol slides are driven full right #2 will yield and move only half way on a CR operation (controls #2 symbol rack).

Program Bails and Program Slides (cont'd)

Sub-Total:

#6 Accumulator total.

#11 Total/sub-total cam program slide.

#14 Hold-up latch disabling.

#5 & #6 Neg Sub-total/Sub-total symbol slides are driven full right. #5 will yield and move only half way on a CR operation (controls #2 symbol rack).

Enter Dividend:

#5 Set-up carriage escapement (and drives #4 to the right).

#4 Set-up carriage engagement (and locks numeral KB and decimal key).

#7 Set-up carriage return (and drives the decimal bail to the right).

#19 Enter dividend.

#1 Dividend symbol slide driven full right (controls #1 symbol rack).

Enter Multiplicand:

#5 Set-up carriage escapement (and drives #4 to the right).

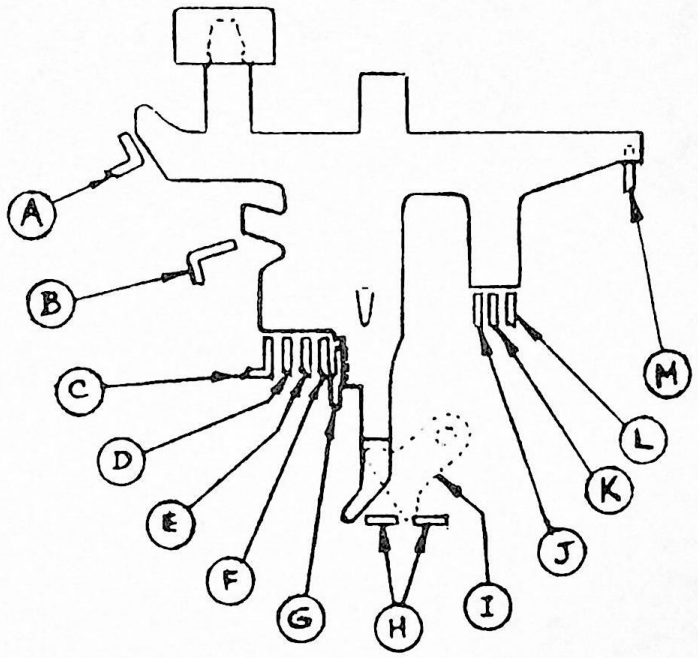
#4 Set-up carriage engagement (and locks numeral KB and decimal key).

#7 Set-up carriage return (and drives the decimal bail to the right).

#17 Enter selector program slide.

#7 Multiplicand symbol slide is driven full right (controls #1 symbol rack).

The function keystems have 13 surfaces which contact and move bails, slides, cams, etc. While no keystem actually has all 13 contact surfaces, we have illustrated below an imaginary "master" keystem that does have them all. The mechanism that is moved by these surfaces is represented in diagram form and identified in the accompanying chart. This mechanism is also shown on the following pages as related to the individual function keystem. In these diagrams, only the mechanism that is actually operated by the keystem is shown.



A - Acc. and Neg. Mult. Bail

B - Keyboard Locking Bail

C - Repeat Shaft

D - Clutch Release Bail

E - Displacement Lock

F - Supplemental Lock

G - Numeral and Dec. Key Lock

H - Program Bail

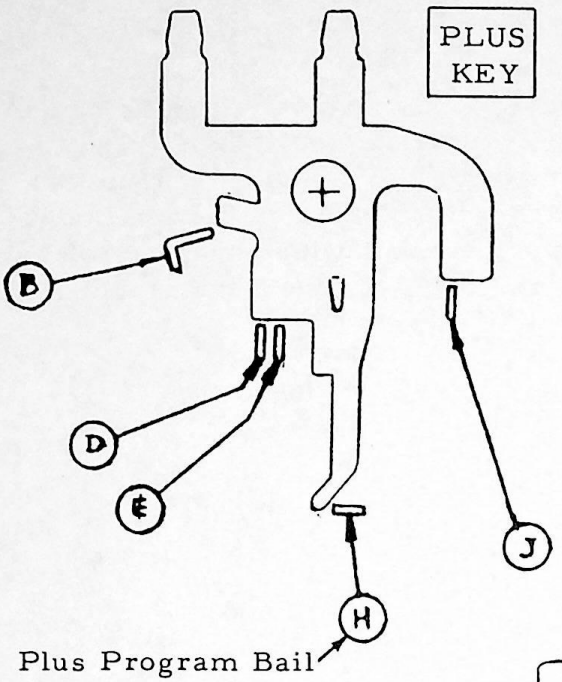
I - Program Bail Bell Crank

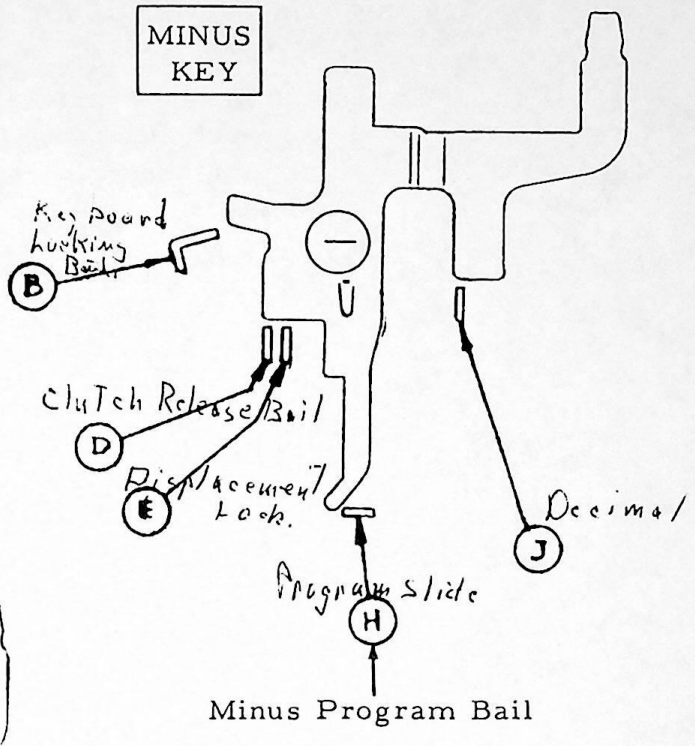
J - Decimal Bail

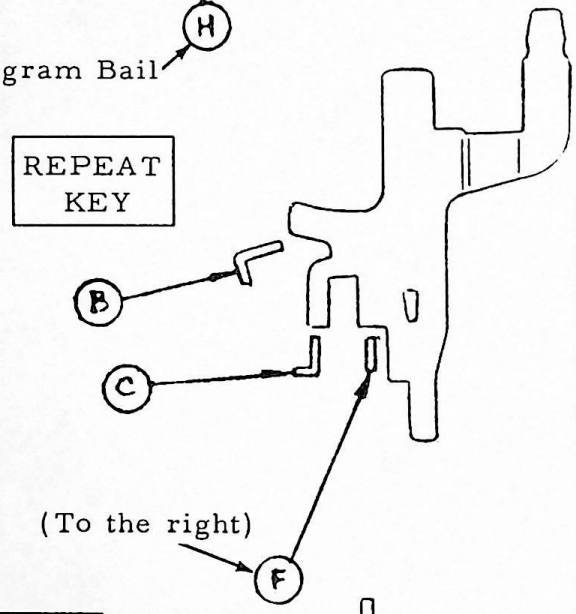
K - Multiplier and Multiplicand Bails

L - Division Bail

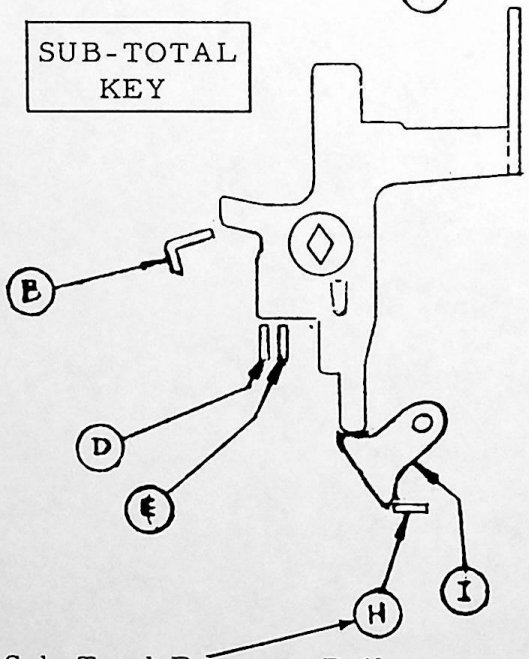
M - Transfer Slide

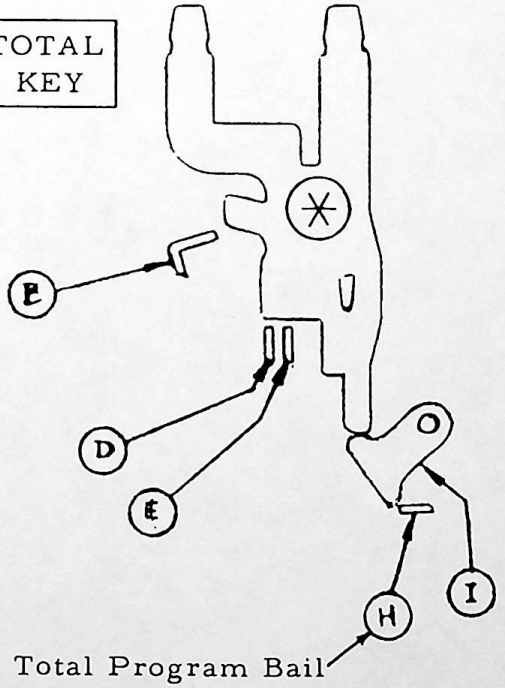


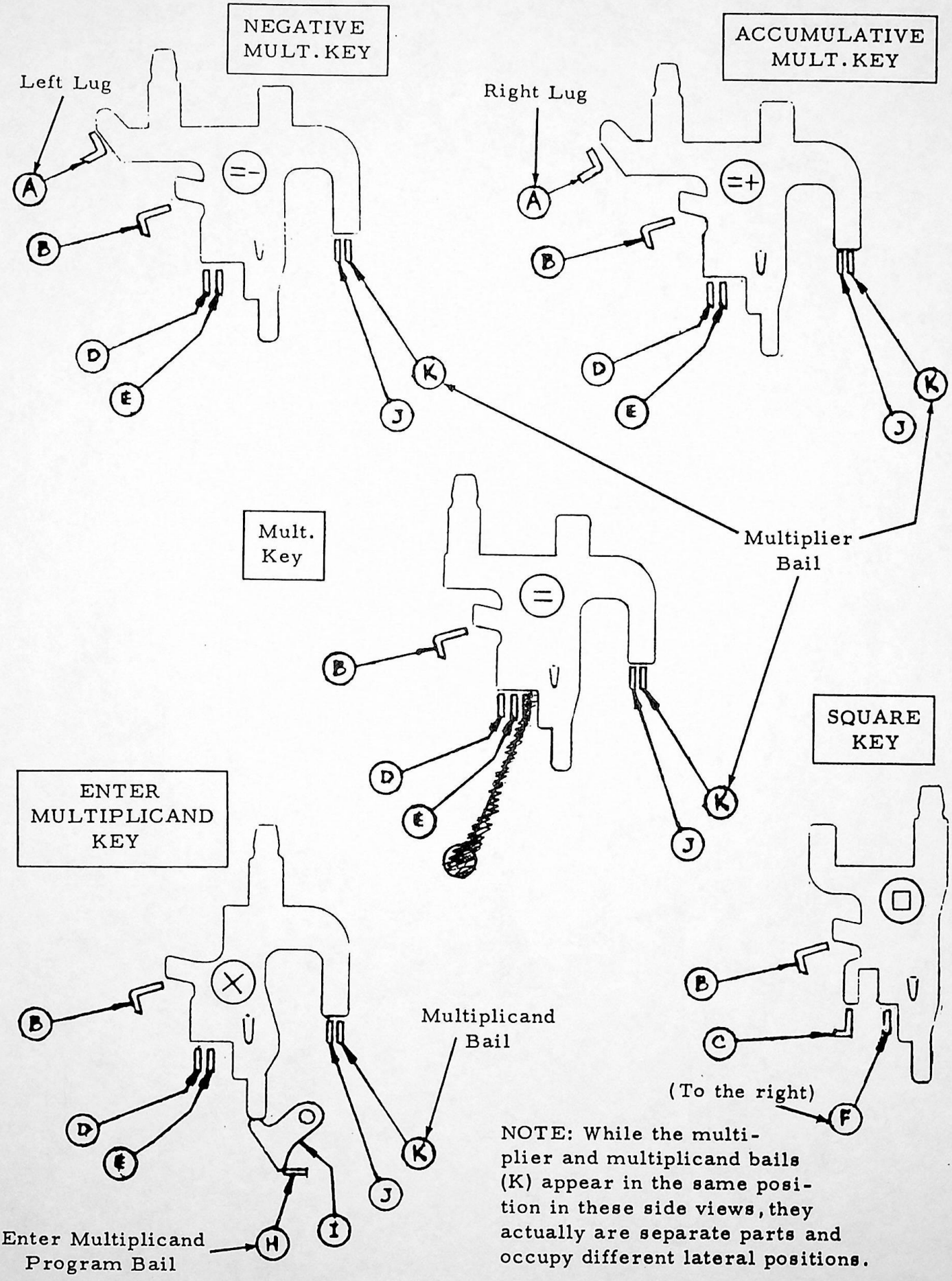




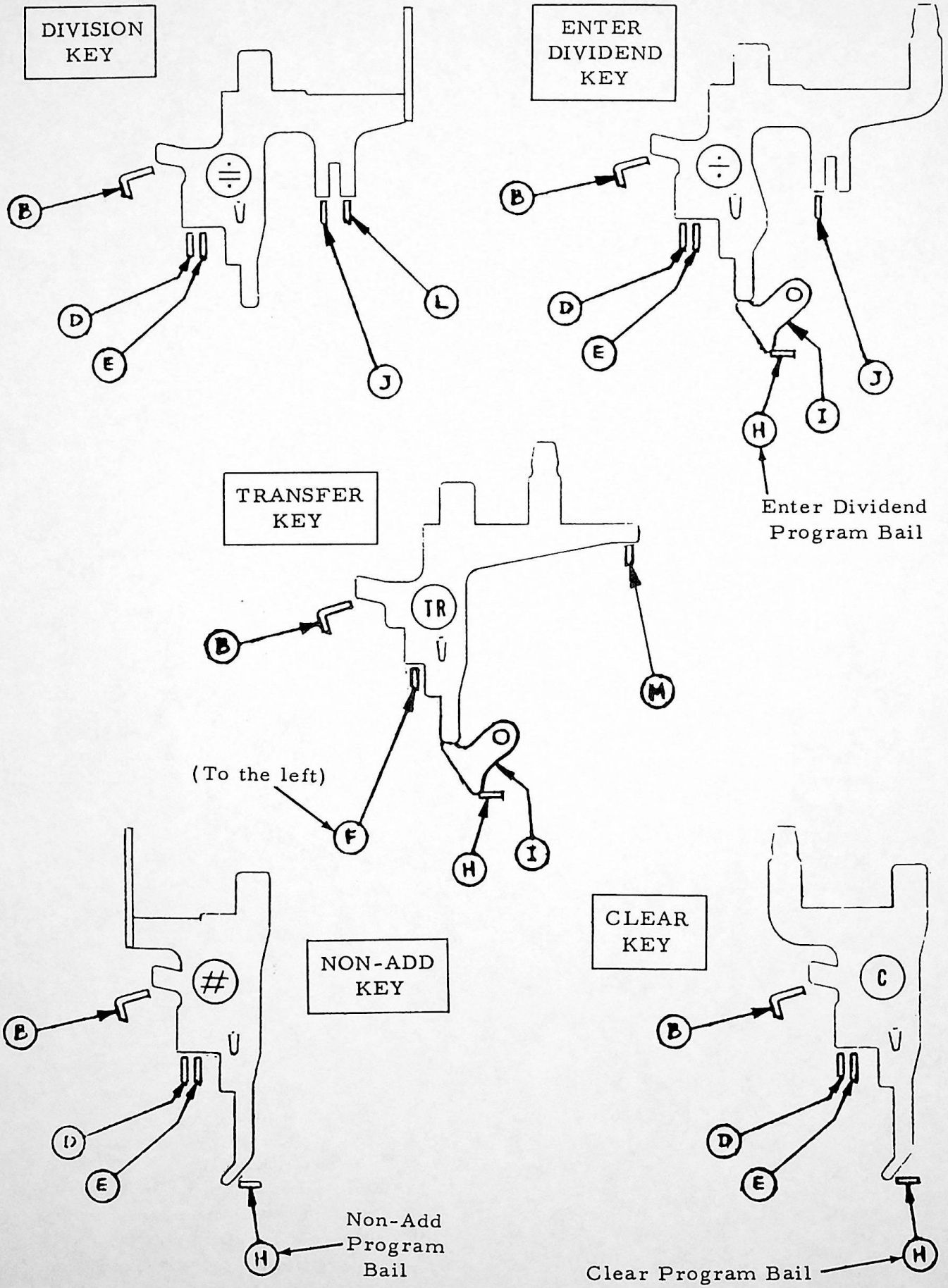
Note that the Plus and Minus keys both actuate the same mechanism; the only exception being the individual program bail involved.
The same is true of the Sub-Total, Total, Non-Add and Clear Keys.



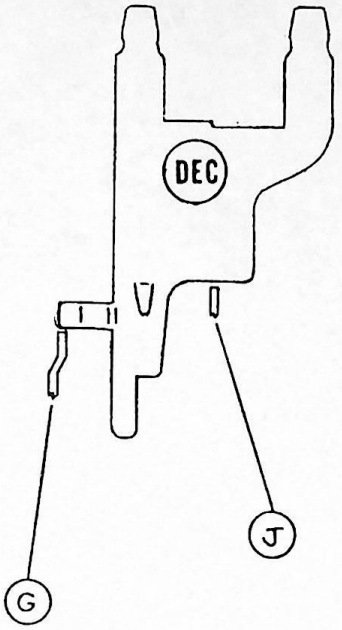




NOTE: While the multiplier and multiplicand bails (K) appear in the same position in these side views, they actually are separate parts and occupy different lateral positions.


DIVISION KEY
B
D
E
J
L
ENTER DIVIDEND KEY
B
D
E
H
I
J
Enter Dividend Program Bail
TRANSFER KEY
TR
B
M
(To the left)
F
H
I
NON-ADD KEY
#
B
D
E
H
Non-Add Program Bail
CLEAR KEY
C
B
D
E
H
Clear Program Bail

DECIMAL KEY

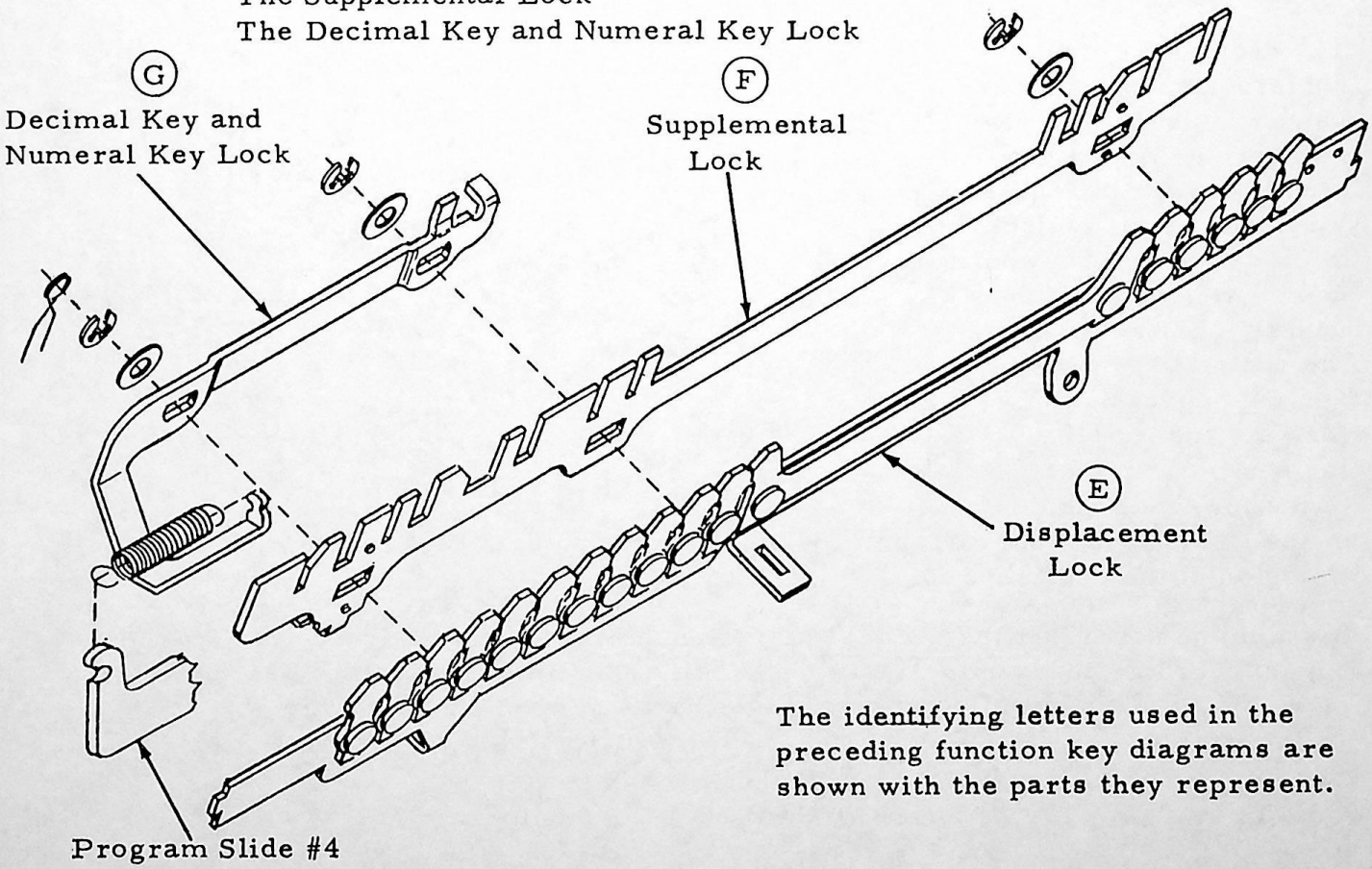


The decimal key operates the decimal bail (J) only... nothing else. It is blocked by lock (G) as described on the next page.

Function Keystem Locks

There are three locking devices located in the program unit under the function keys. They are:

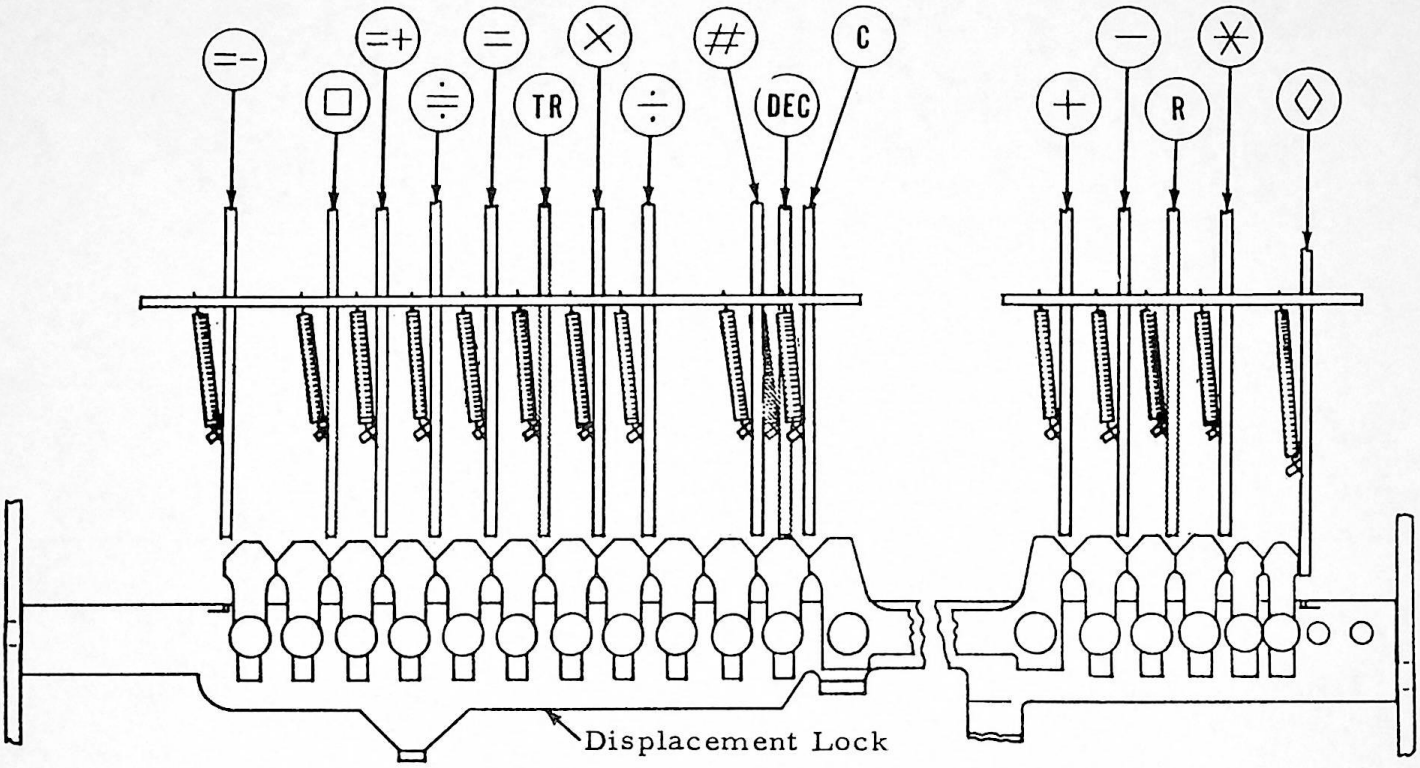
The Displacement Lock
The Supplemental Lock
The Decimal Key and Numeral Key Lock



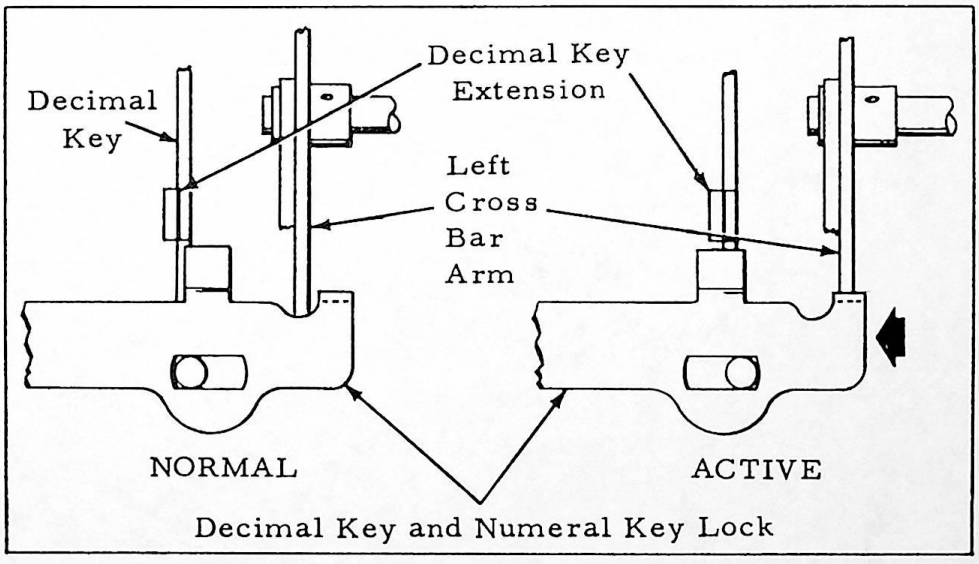
The identifying letters used in the preceding function key diagrams are shown with the parts they represent.

The displacement lock prevents depression of more than one "live" function key at a time. (The illustration below shows the sub-total key depressed).

Dotted lines indicate the "dead" keys (square, transfer, decimal and repeat). These keys do not engage the displacement lock.



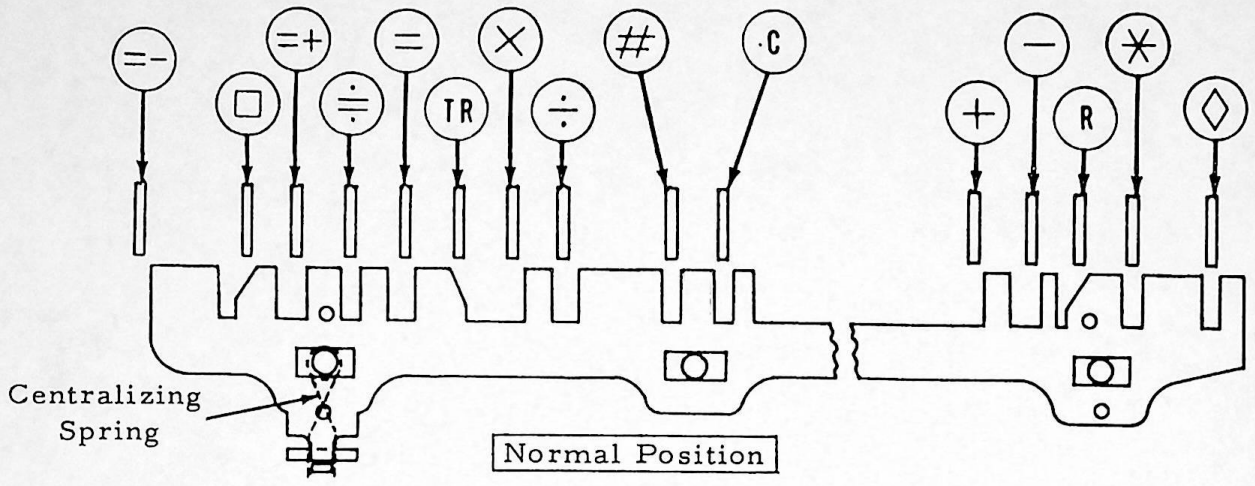
The decimal key and numeral key lock is activated whenever the set-up carriage is programmed to engage the racks. When activated, the lock is moved to the left where one of its lugs positions under an extension of the decimal key (preventing depression of the key) and its other lug positions in front of the lower extension of the left arm that carries the cross bar of the numeral keyboard (preventing depression of the numeral keys).



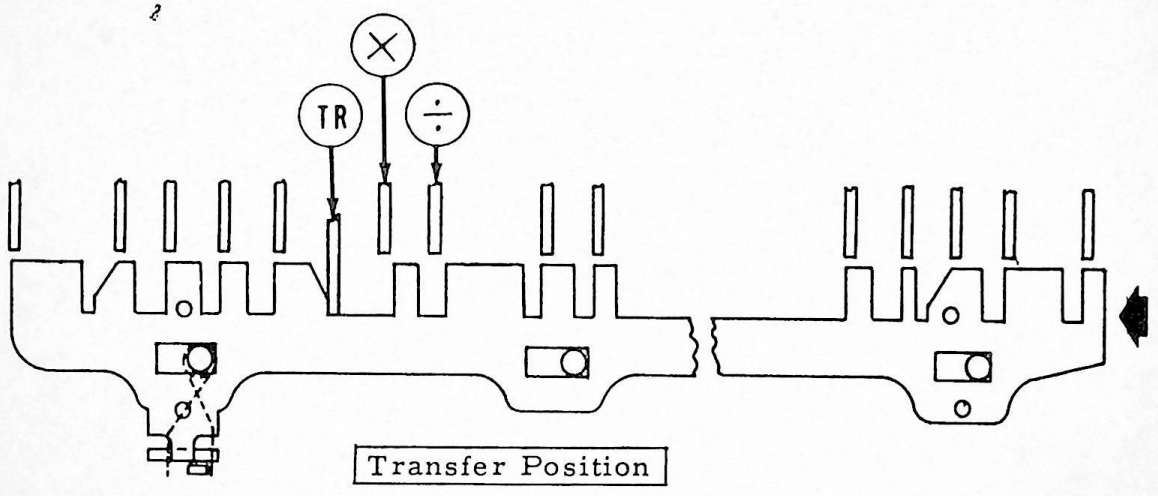
Decimal Key and Numeral Key Lock

It should be noted that the decimal key and numeral keys are locked only when the ~~set-up~~ carriage engages the racks. . . . At all other times these keys are "open" and entries can be made while the machine is performing other calculations.

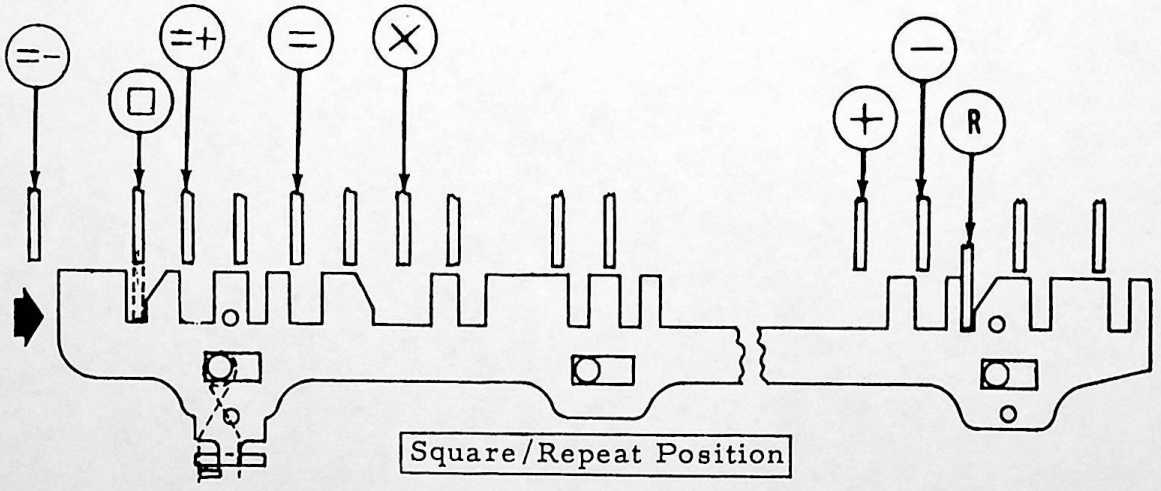
Only when the set up carriage engaging # / program bail is active. Also when the setup carriage is not returned to the home position.



The Supplemental Lock is normally held in the middle position by a centralizing spring.

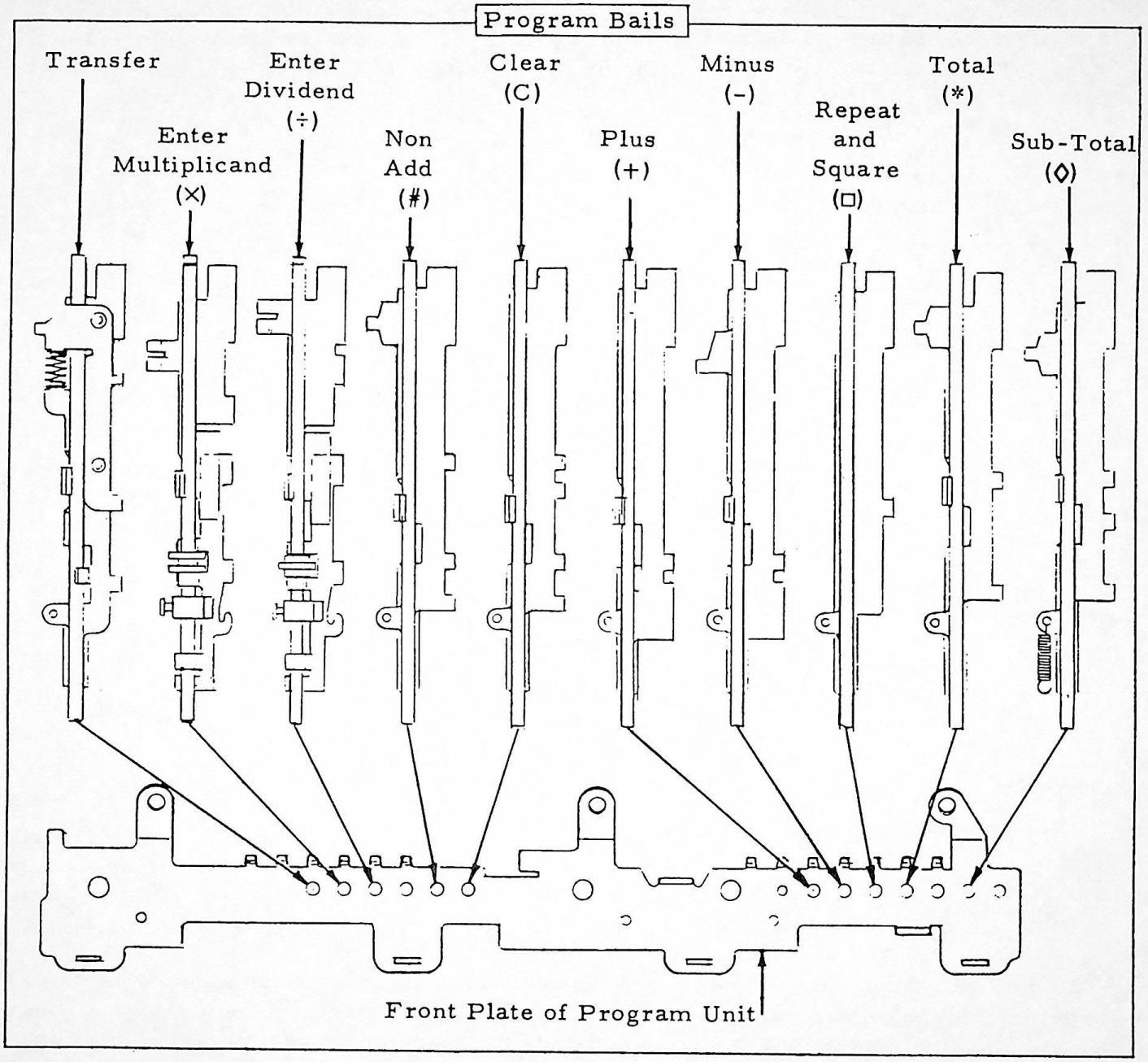


The Supplemental Lock is operated to the left by the Transfer Key. This prevents depression of all function keys except the Enter Multiplicand (×) or Enter Dividend (÷).



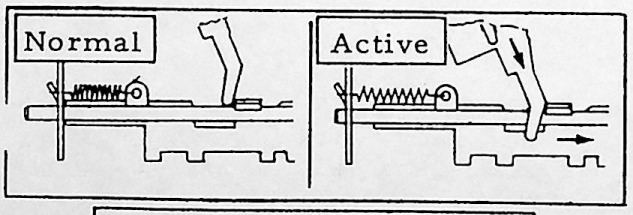
The Supplemental Lock is operated to the right by the Square Key and the Repeat Key. This prevents depression of all function keys except: Plus or Minus or Neg. Mult. or Acc. Mult. or Mult. or Enter Multiplicand.

The program unit contains a group of ten program bails.

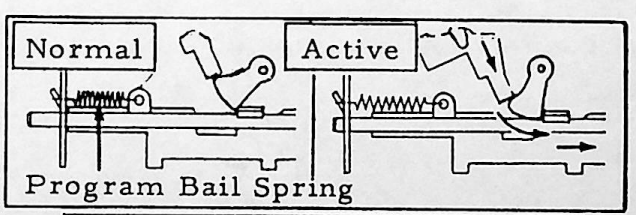


These program bails are moved rearward by the function keystems which either directly engage an offset lug on the program bail or pivot a bell crank which in turn engages an offset lug of the program bail.

Note: The program bail springs restore the program bails to neutral when the function keys are released near the end of the cycle.



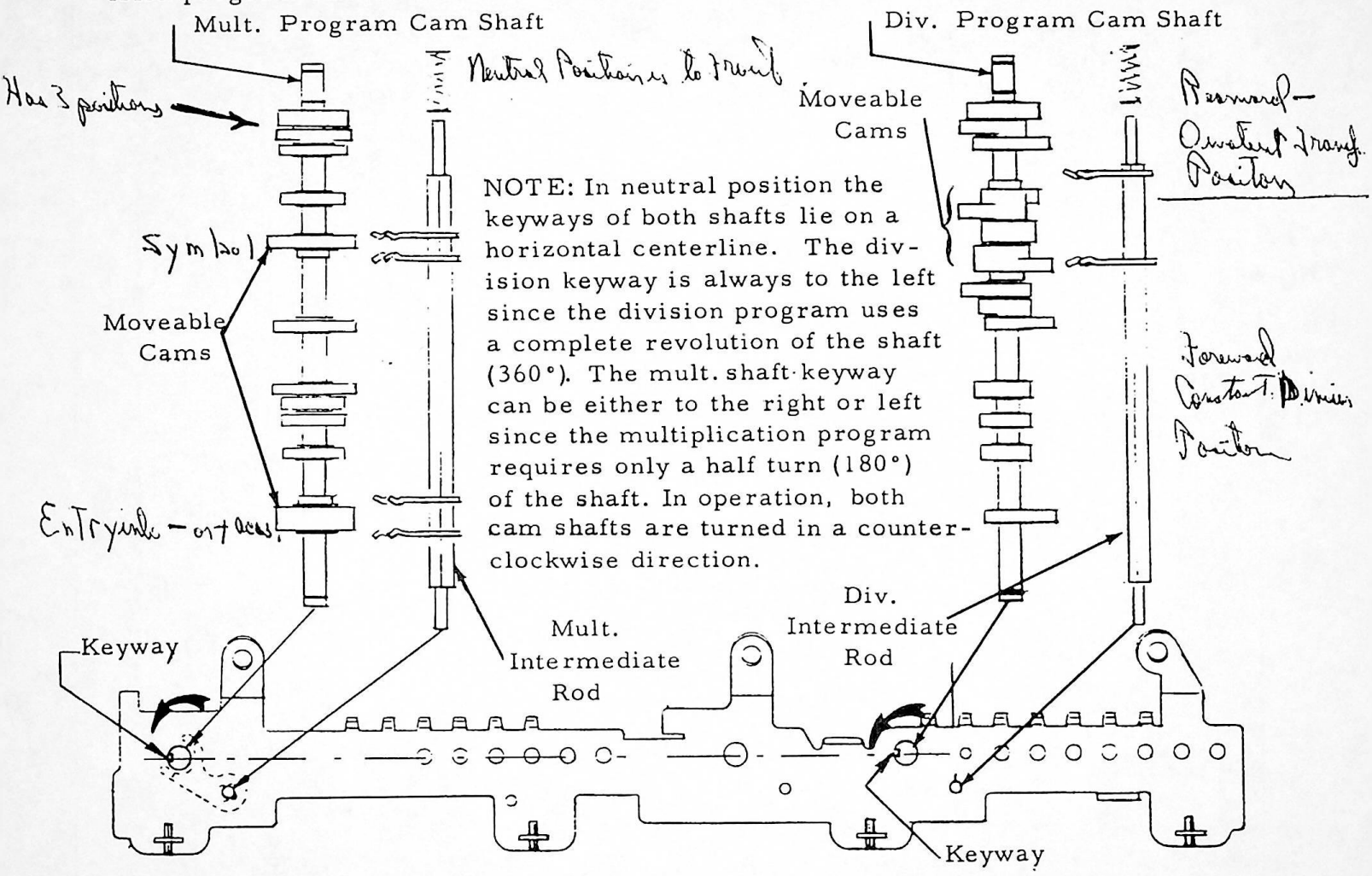
Direct Engagement Type



Intermediate Bell Crank Type

PROGRAM CAM SHAFTS

Note that program bails shown on the preceding page are identified with Single Cycle functions. . . . That is, those operations that require only one cycle of the machine to complete.* For the more complex Multiple Cycle functions, program cam shafts are used. There are two such shafts; the multiplication program cam shaft and the division program cam shaft.


Mult. Program Cam Shaft
Div. Program Cam Shaft
Moveable Cams
Moveable Cams
NOTE: In neutral position the keyways of both shafts lie on a horizontal centerline. The division keyway is always to the left since the division program uses a complete revolution of the shaft (360°). The mult. shaft keyway can be either to the right or left since the multiplication program requires only a half turn (180°) of the shaft. In operation, both cam shafts are turned in a counter-clockwise direction.
Keyway
Mult. Intermediate Rod
Div. Intermediate Rod
Keyway

The multiplication program cam shaft has two movable cams. The movable cams are positioned by an intermediate rod which is controlled by the acc. /neg. mult. bail. The position of the front cam determines whether the machine performs plain multiplication. . . accumulative multiplication. . . or negative multiplication when the mult. program cam shaft is activated. The rear cam selects the proper symbols for the multiplication being performed.

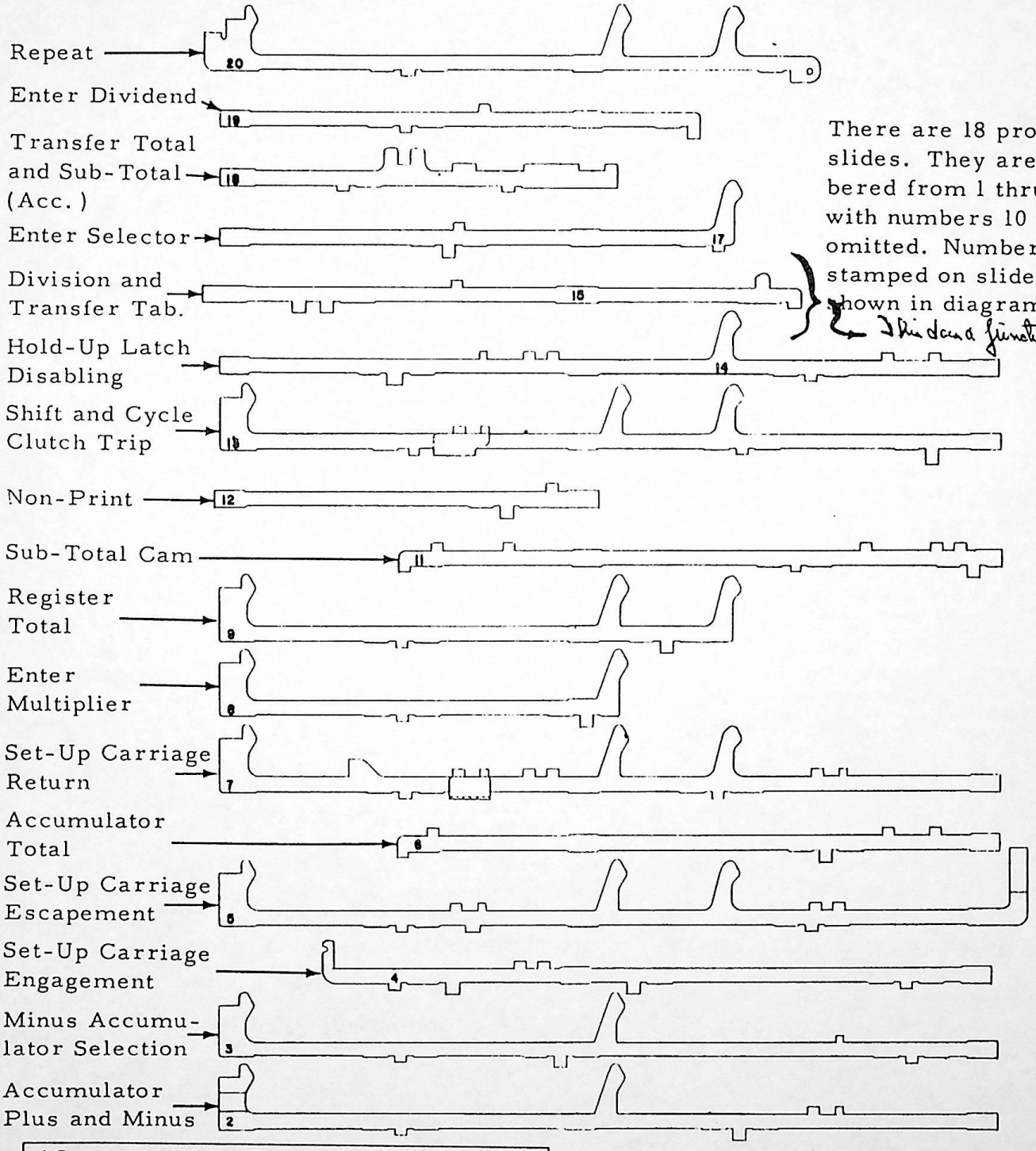
The division program cam shaft contains a group of movable cams which are also positioned by an intermediate rod. This rod is controlled by the Constant Divisor/ Quotient Transfer Lever; the cams select the proper symbolization and determine whether or not the quotient is transferred to the selector.

*Exception: The repeat/square program bail can be used in conjunction with the three multiplication keys.

PROGRAM SLIDES

The program bails and program cam shafts are positioned above and at right angles to the program slides.

Each program bail has one or more lugs projecting downward. These lugs and the cams of the program cam shafts operate the required program slides to the left.*



There are 18 program slides. They are numbered from 1 thru 20 with numbers 10 and 16 omitted. Numbers are stamped on slides as shown in diagram.

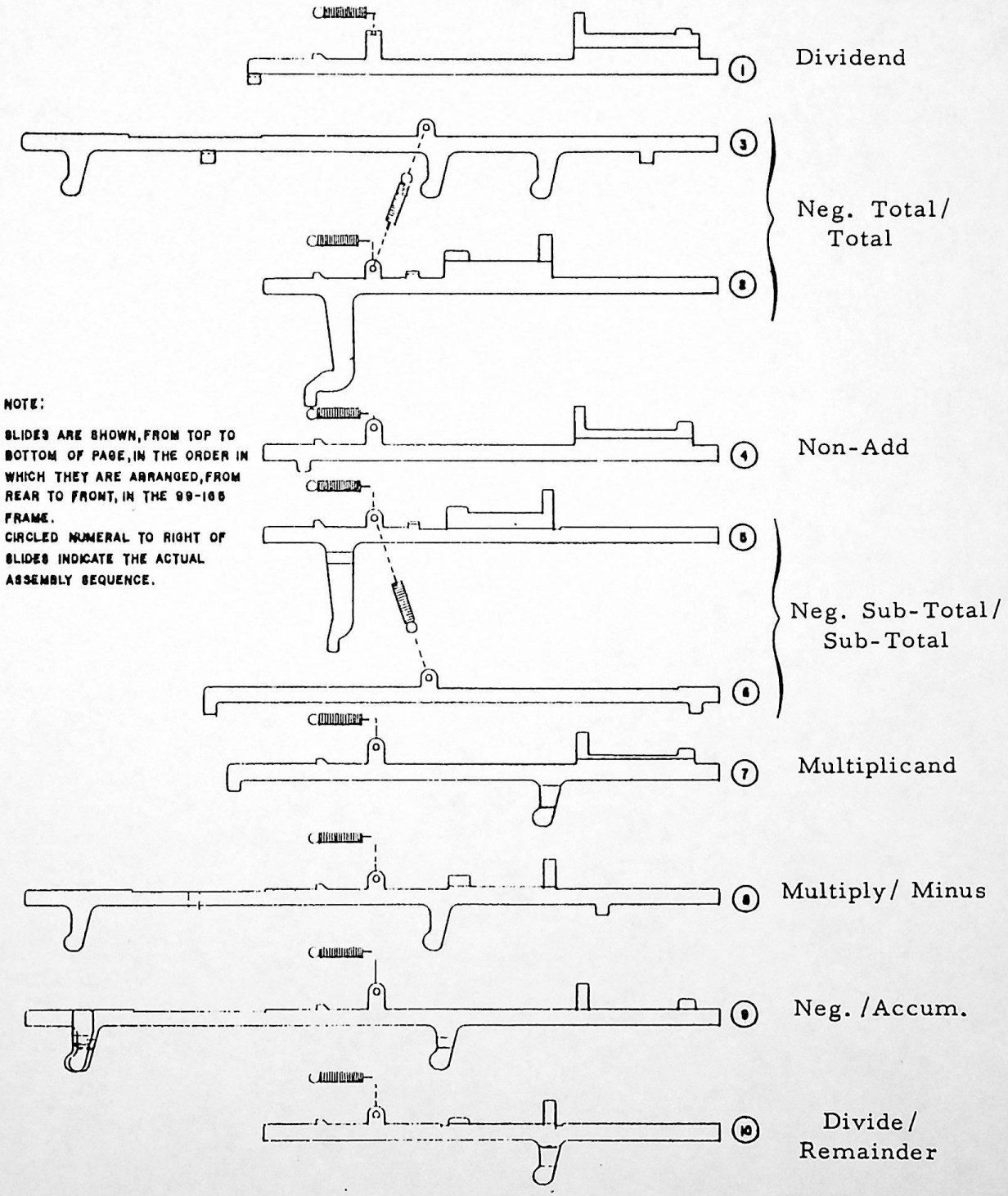
This does a function by going to right

*One exception: Program slide No. 15 ...for div. and transfer...is operated to the right by the div. program cam shaft and to the left by the multiplicand program bail on transfer functions.

SYMBOL SLIDES

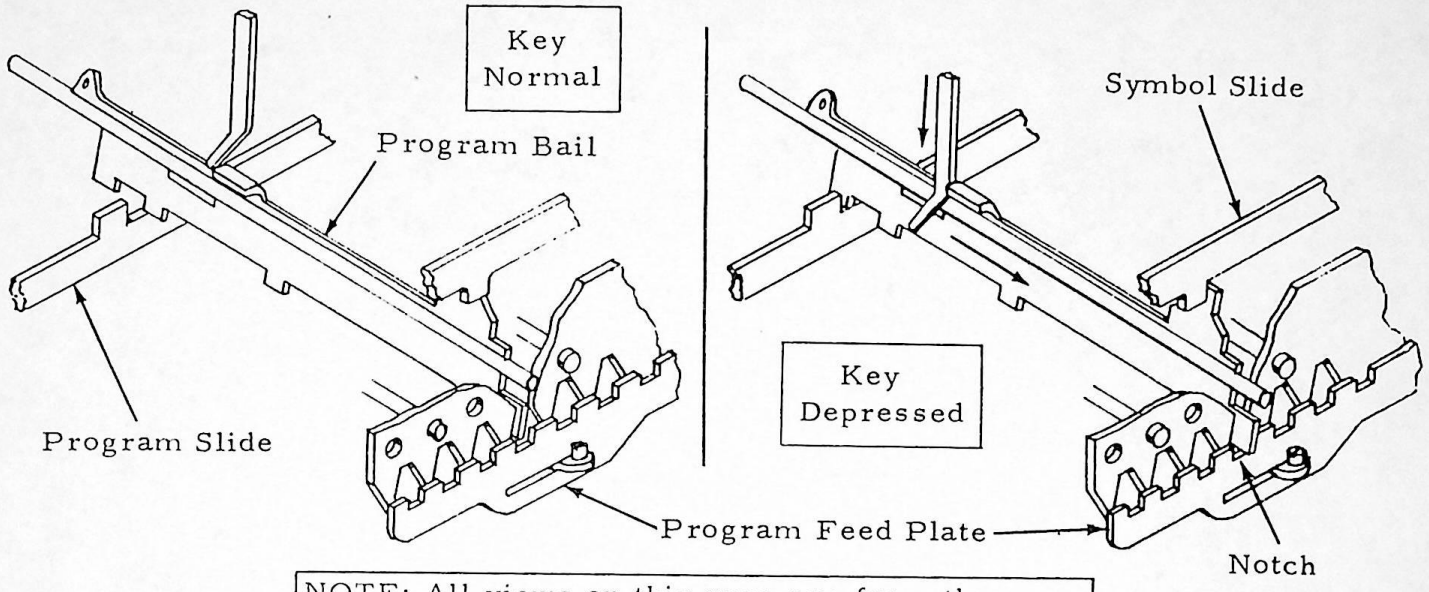
The program bails and program cam shafts are positioned below and at right angles to the symbol slides.

Some program bails have lugs projecting upward. These lugs and certain cams of the program cam shafts operate the selected symbol slides to the right.



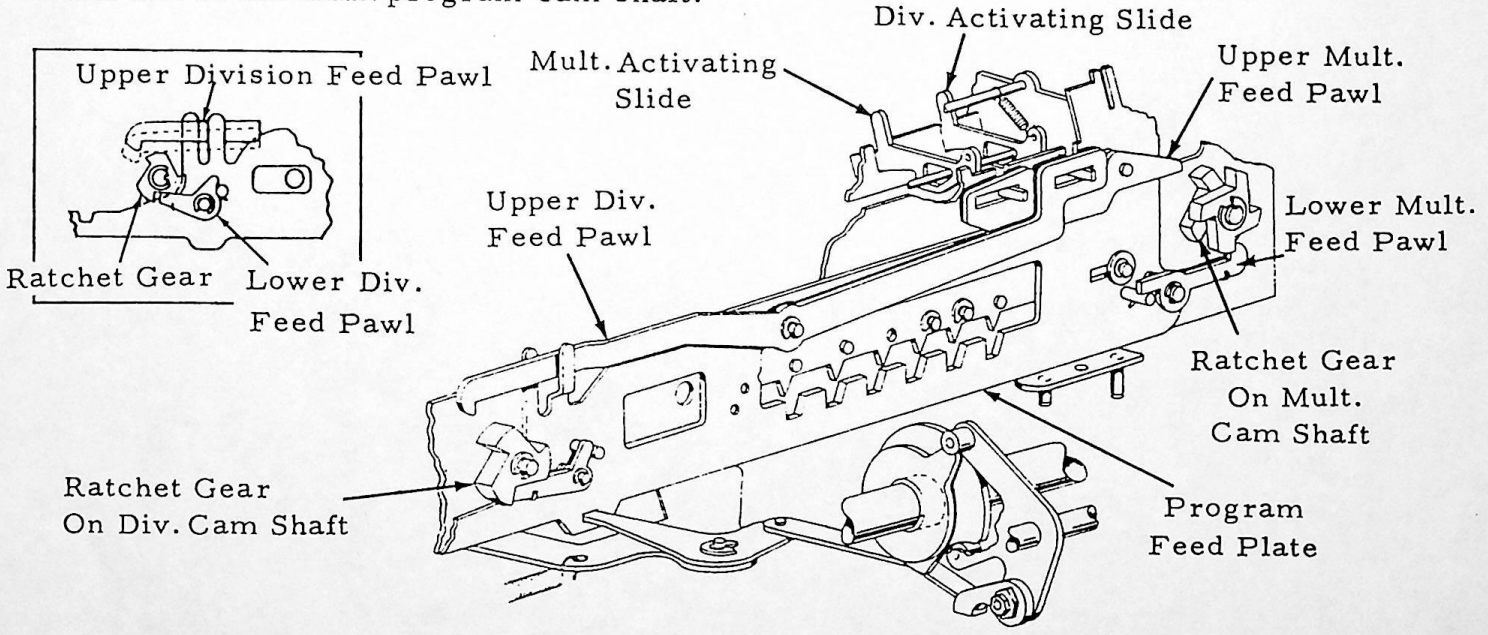
PROGRAM FEED

When a program bail is operated rearward by a function key, it engages in a notch of the program feed plate.



NOTE: All views on this page are from the rear.

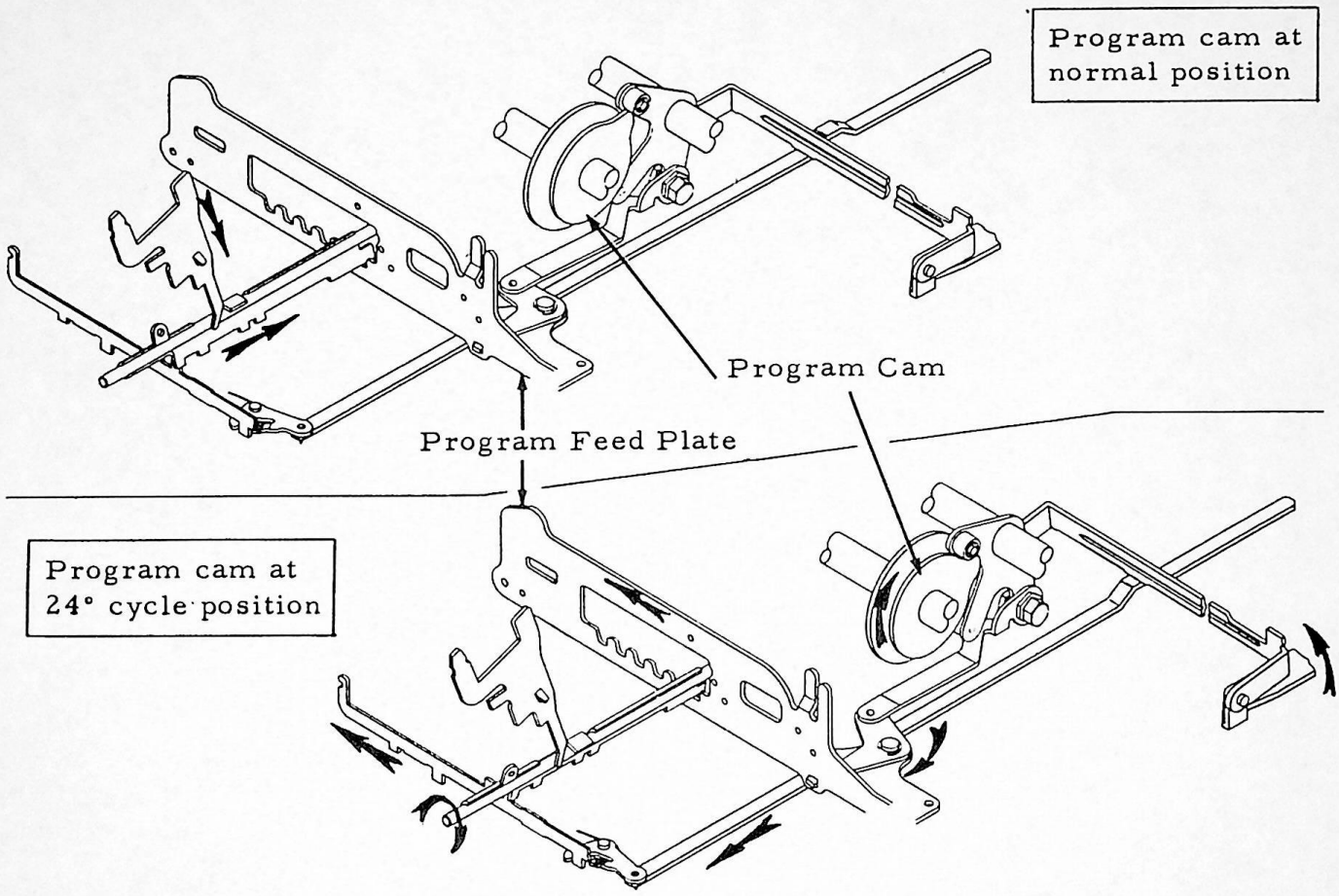
When one of the multiplication keys is depressed, it pivots the multiplier bail. A stud on the multiplier bail pushes the mult. activating slide up and to the rear. This movement of the slide pivots the upper mult. feed pawl into engagment with the ratchet gear on the end of the mult. program cam shaft.



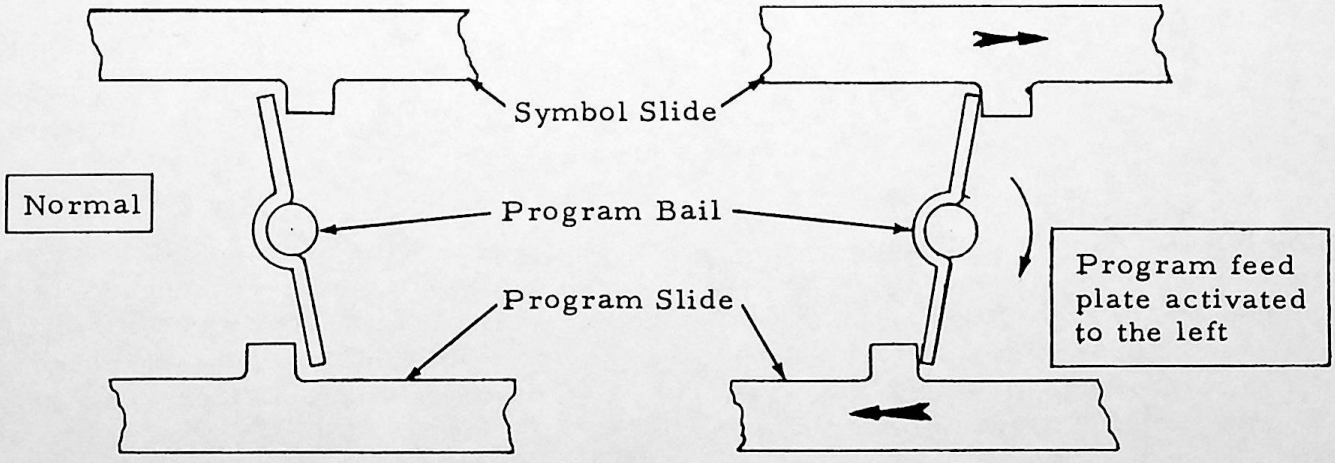
Likewise... when the division key is depressed, it pivots the division bail and a stud on the division bail pushes the division activating slide to the rear. As the slide moves rearward its spring pulls the rear end upward. This movement of the slide pivots the upper division feed pawl into engagement with the ratchet gear on the end of the div. program cam shaft. The mult. feed pawls and the div. feed pawls are mounted on the program feed plate.

It is therefore apparent that whenever a "live" function key is depressed, it causes an engagement with the program feed plate.

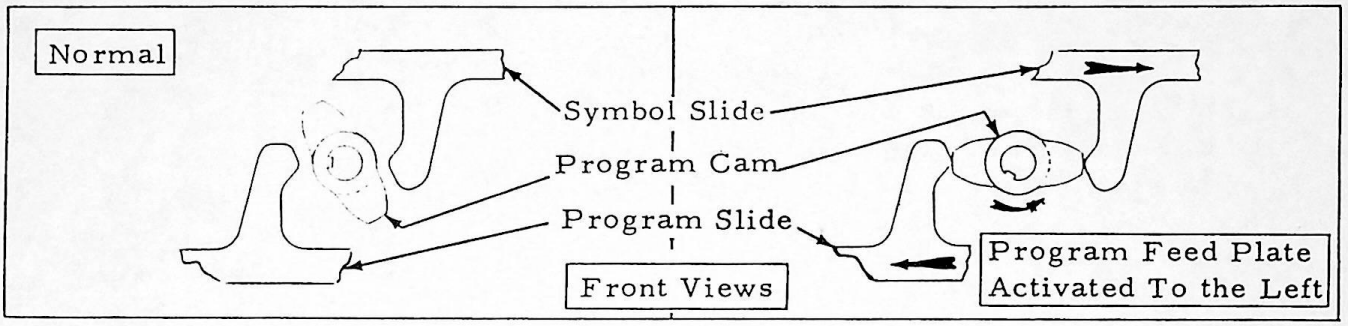
The program feed plate is driven to the left by the program cam on the main cam shaft during the first 24° of the cycle.



In the case of a single cycle function key, the movement of the program feed plate rocks the selected program bail in a clockwise direction. The program bail moves the required program slides to the left and symbol slide (if a symbol is called for) to the right.



In the case of a multiple cycle function key, the movement of the program feed plate would index the selected program cam shaft in a counter-clockwise direction to its first detented position. The cams would actuate the required program and symbol slides.

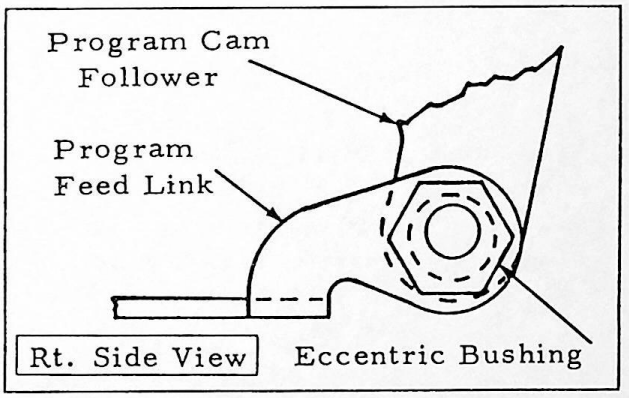


Adjustment

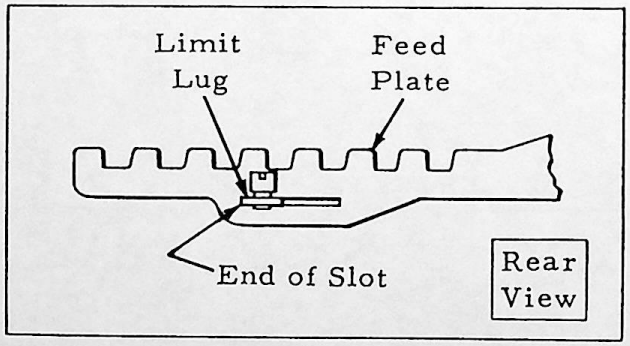
The position of the program feed plate is adjustable thru an eccentric bushing which connects the program cam follower and the program feed link.

Adjustment is made with motor cord removed....Use a hand crank to cycle the machine.

Adjustment should be started with wide section of eccentric "down" to obtain maximum leverage from cam follower. Loosen lock nut just slightly and turn eccentric to this position.



The initial setting is made to obtain maximum stroke of the feed plate when activated to the left...without cramping at the limit lug of the program unit bottom plate. This initial setting must be made with no program feed load.



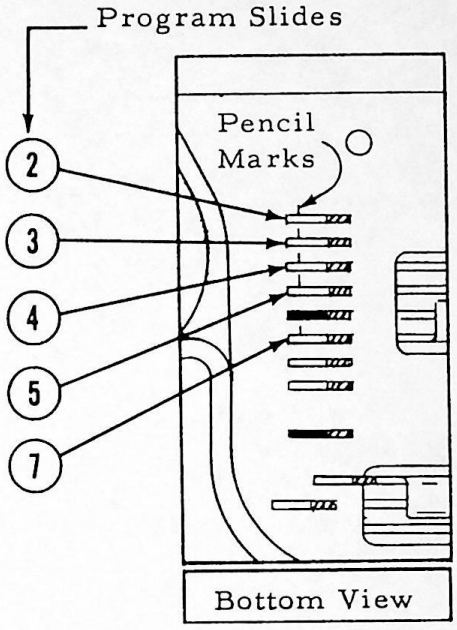
1. To adjust...manually trip the main cam shaft clutch latch and cycle to the hold-up position (30°). Adjust the eccentric so that end of feed plate slot just touches limit lug on bottom plate of program unit...without cramping.

Program Feed Adjustment (cont'd)

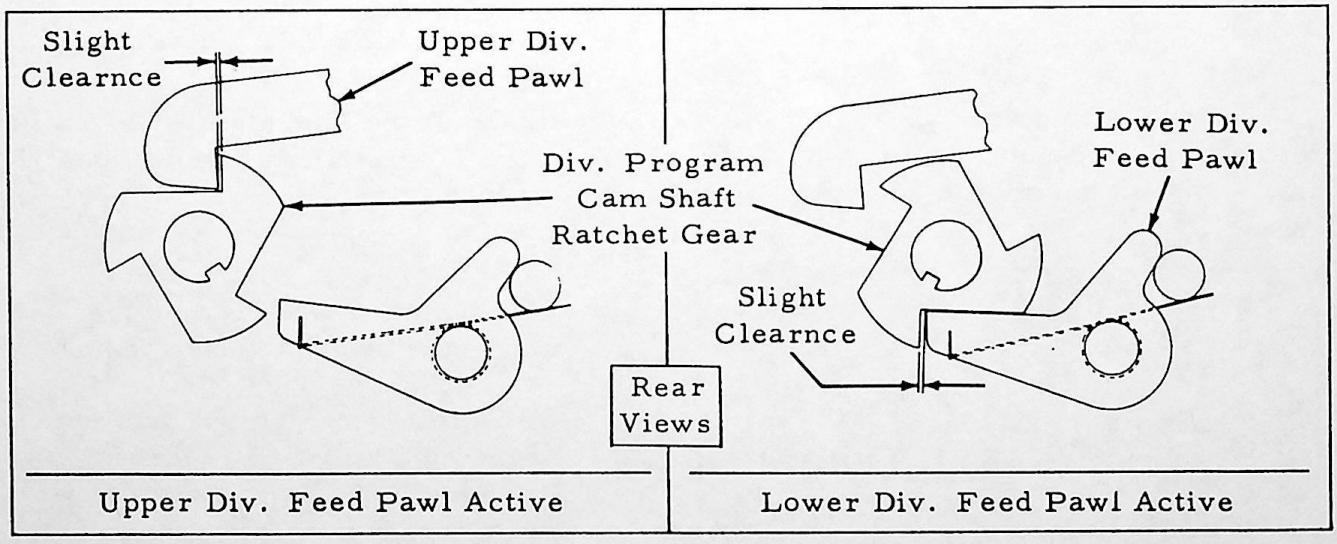
2. Tighten the lock nut and check for the following conditions:

a. Complete the machine cycle with the hand crank and check that the other end of the feed plate slot does not cramp the limit lug in the "home" position.

b. Program slides should be displaced very near the same amount by the program bails as they are by the program cams... To check, depress Neg. Mult. key and cycle machine until program feed plate moves fully to the left... Mark the displaced position of program slides #4, #5 and #7 with a pencil on the bottom plate. Continue cycling and also mark the displaced position of program slides #2 and #3 during the product cycle. Now depress the minus key and again cycle machine until program feed plate moves fully to the left... Check that program slides #2, #3, #4, #5 and #7 are displaced to within 1/64" of the positions marked for neg. mult.



c. Check that division feed pawls turn division program cam shaft to fully detented position in both directions without any "overthrow" of shaft.... There should be very slight clearance between the active pawl and ratchet gear in each of the six detent positions of the division operations.

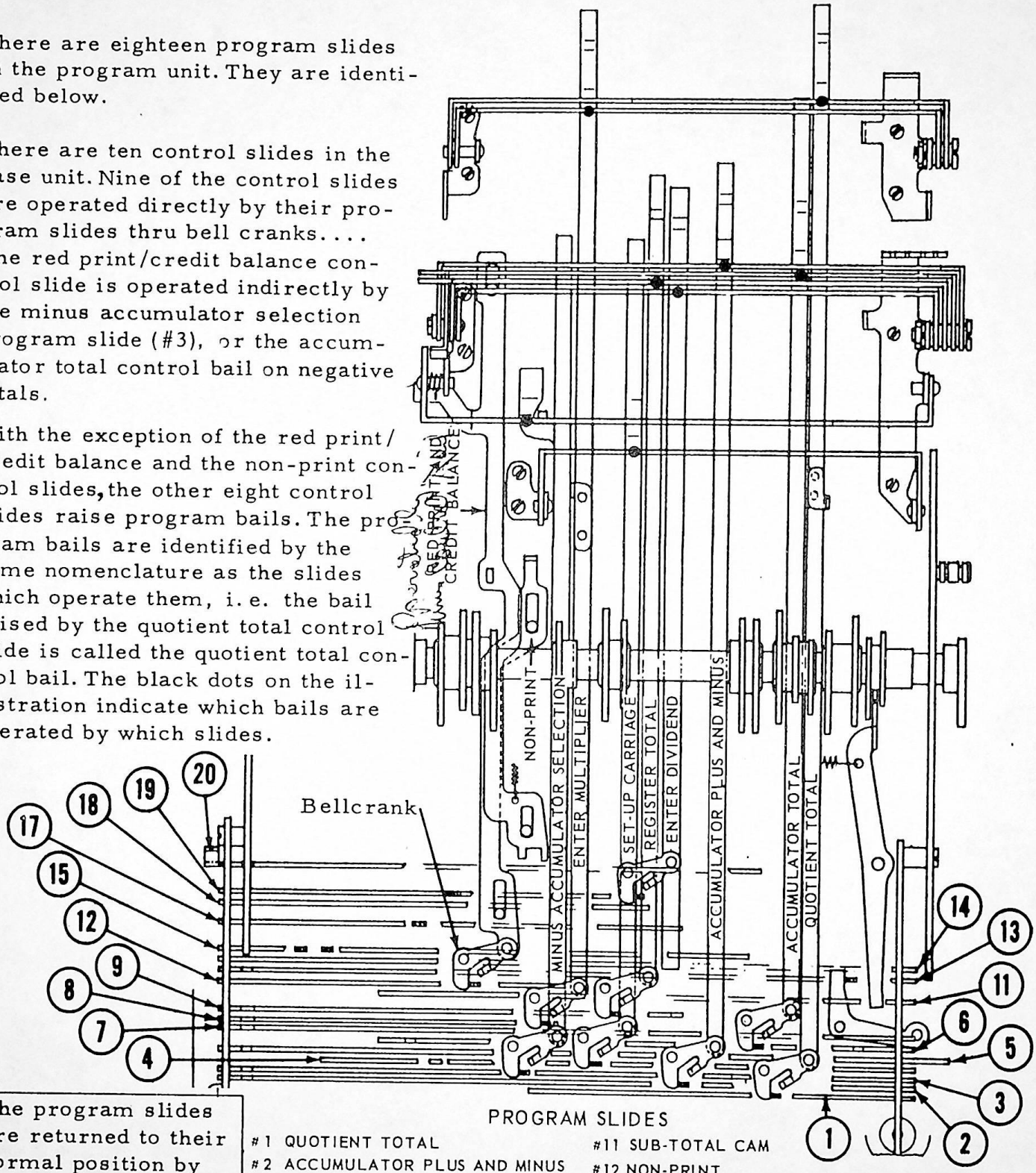


PROGRAM SLIDES - CONTROL SLIDES - CONTROL BAILS

There are eighteen program slides in the program unit. They are identified below.

There are ten control slides in the base unit. Nine of the control slides are operated directly by their program slides thru bell cranks.... The red print/credit balance control slide is operated indirectly by the minus accumulator selection program slide (#3), or the accumulator total control bail on negative totals.

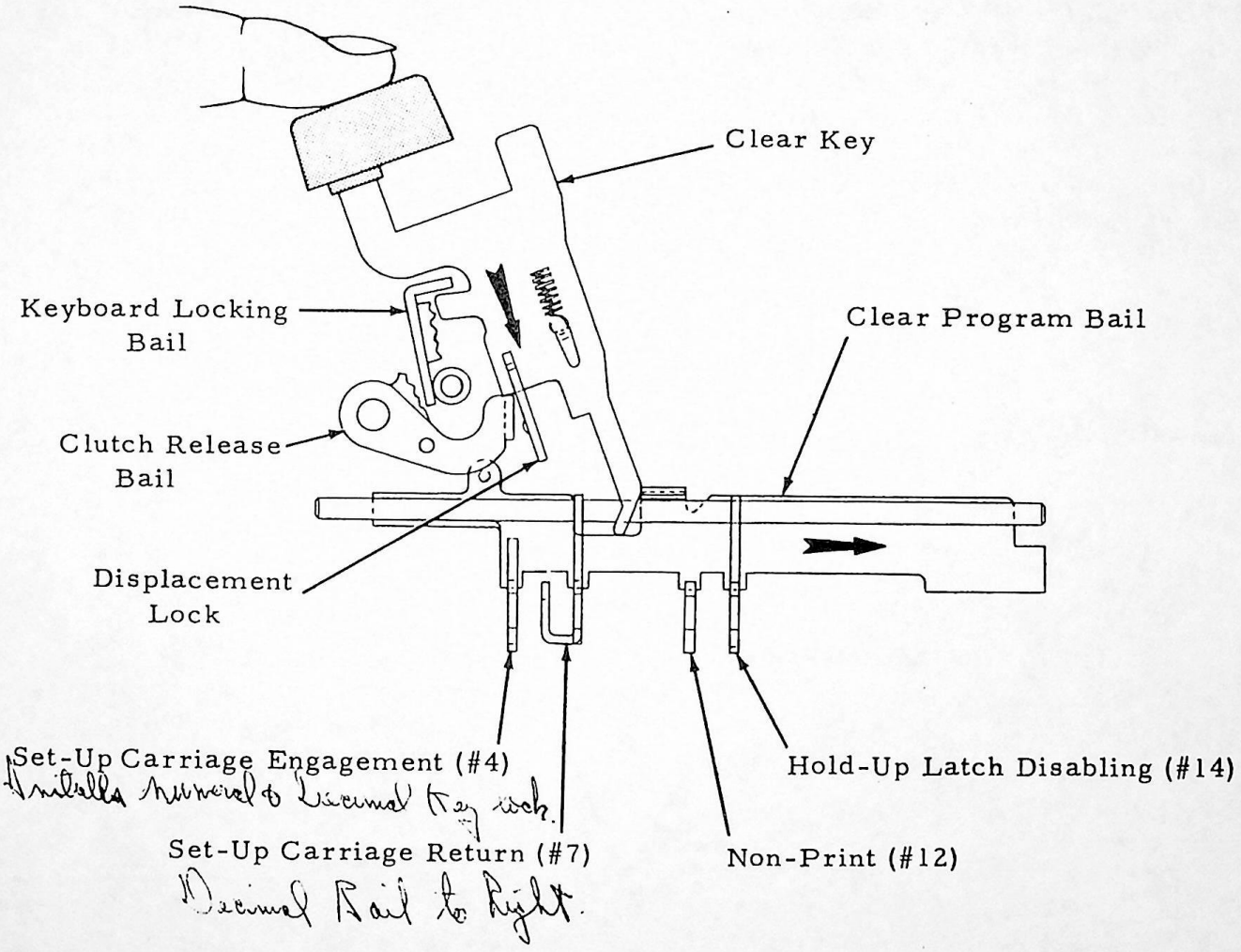
With the exception of the red print/credit balance and the non-print control slides, the other eight control slides raise program bails. The program bails are identified by the same nomenclature as the slides which operate them, i.e. the bail raised by the quotient total control slide is called the quotient total control bail. The black dots on the illustration indicate which bails are operated by which slides.



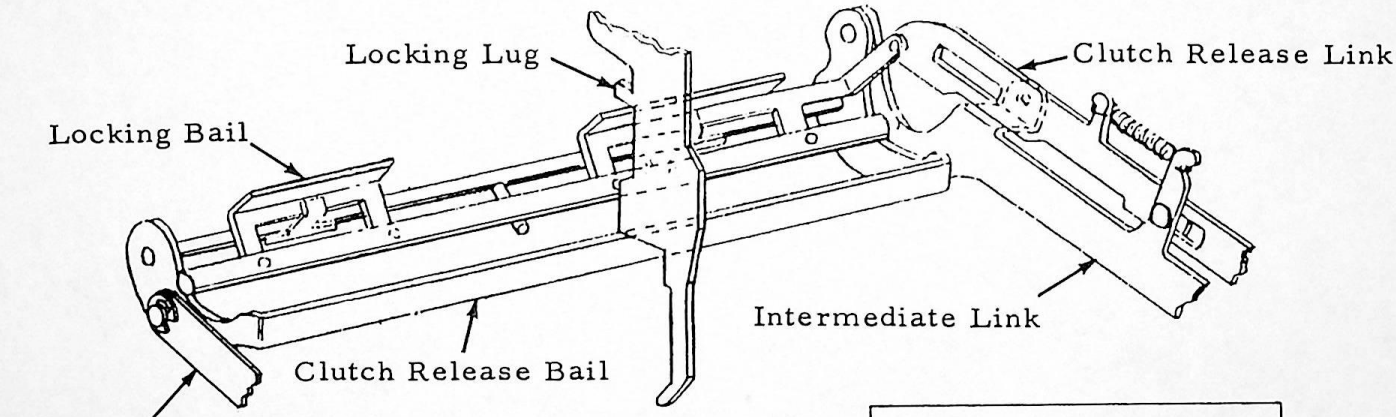
The program slides are returned to their normal position by the program bail springs. The bell cranks and control slides are returned to their normal positions by torsion springs.

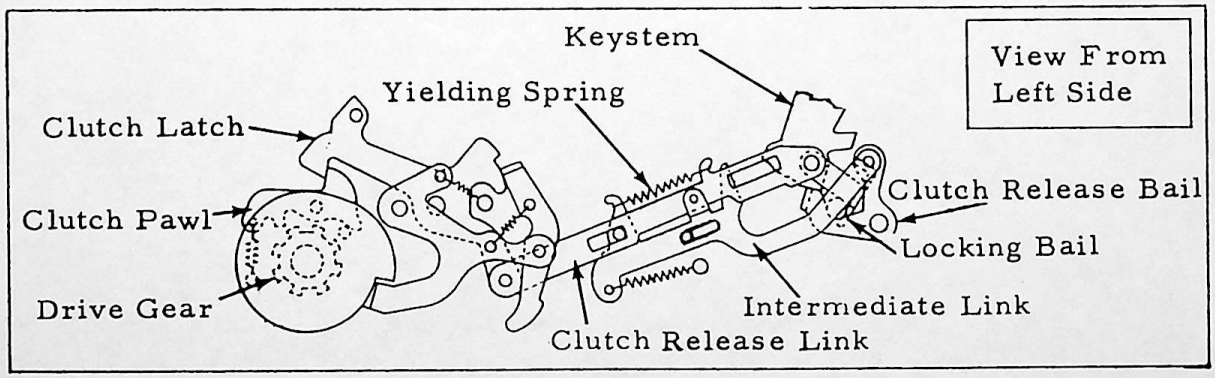
PROGRAM SLIDES

#1 QUOTIENT TOTAL
#2 ACCUMULATOR PLUS AND MINUS
#3 MINUS ACCUMULATOR SELECTION
#4 SET-UP CARRIAGE ENGAGEMENT
#5 SET-UP CARRIAGE ESCAPEMENT
#6 ACCUMULATOR TOTAL
#7 SET-UP CARRIAGE RETURN
#8 ENTER MULTIPLIER
#9 REGISTER TOTAL
#11 SUB-TOTAL CAM
#12 NON-PRINT
#13 SHIFT AND CYCLE CLUTCHTRIP
#14 HOLD-UP LATCH DISABLING
#15 DIV. AND TRANSFER TAB
#17 ENTER SELECTOR
#18 TRANSFER TOTAL AND SUB-TOTAL (ACC.)
#19 ENTER DIVIDEND
#20 REPEAT


Clear Key
Keyboard Locking Bail
Clear Program Bail
Clutch Release Bail
Displacement Lock
Set-Up Carriage Engagement (#4)
Initials removed to Decimal Key each.
Hold-Up Latch Disabling (#14)
Set-Up Carriage Return (#7)
Decimal Rail to Right.
Non-Print (#12)

When the Clear key (or any "live" key) is depressed, it engages the clutch release bail, causing the bail to pivot. An intermediate link, attached to the left end of the clutch release bail, is moved rearward as the bail pivots. This link is connected to the clutch release link by a spring and, as the intermediate link moves rearward, it starts to move the clutch release link rearward with it. The clutch release link however, is attached to the locking bail and as soon as the links start to move rearward, the locking bail contacts the lock lug of the keystem. This momentarily stops the clutch release link and locking bail from moving rearward. The intermediate link continues moving rearward however, and this loads the spring that connects the two links. When the keystem has been depressed far enough for all of its activating surfaces to have fully positioned their respective members, the lock lug moves out of the path of the locking bail. The locking bail is pivoted over the top of the lock lug (locking the keystem down) as the clutch release link is pulled rearward by the loaded spring. This rearward movement of the clutch release link pivots the clutch latch out of engagement with the main cam shaft clutch pawl. The clutch pawl is pulled, by its spring, into engagement with its rotating drive gear and the main shaft starts to rotate.



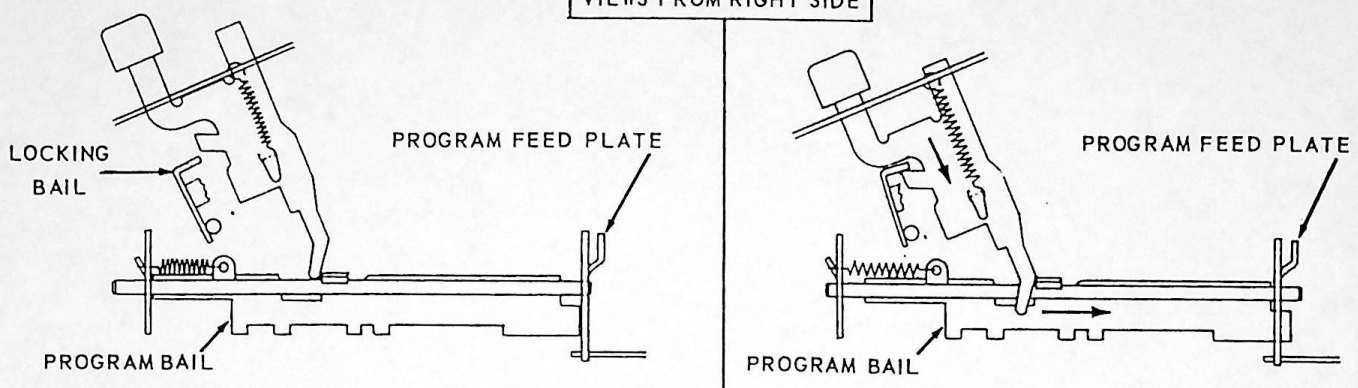


CLUTCH RELEASE LINK NORMAL POSITION

Program Bail Normal Position

Program Bail Rearward Position

VIEWS FROM RIGHT SIDE

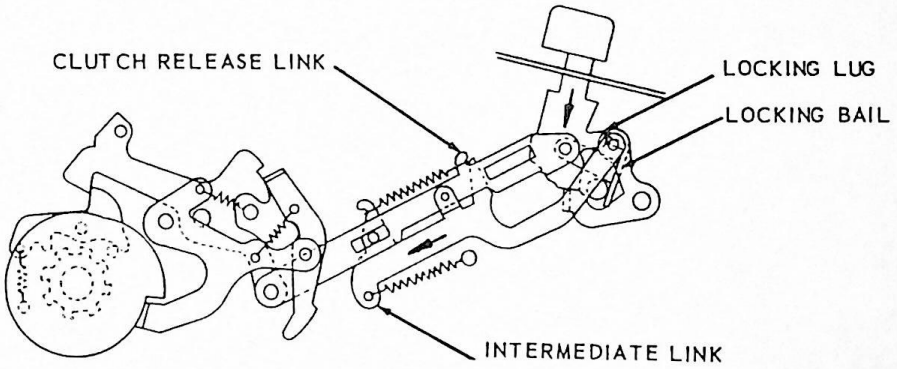


The program bail in its forward position is not engaged with the program feed plate.

The lower end of the keystem positions the program bail rearward. The rearward end of the program bail enters the program feed plate.

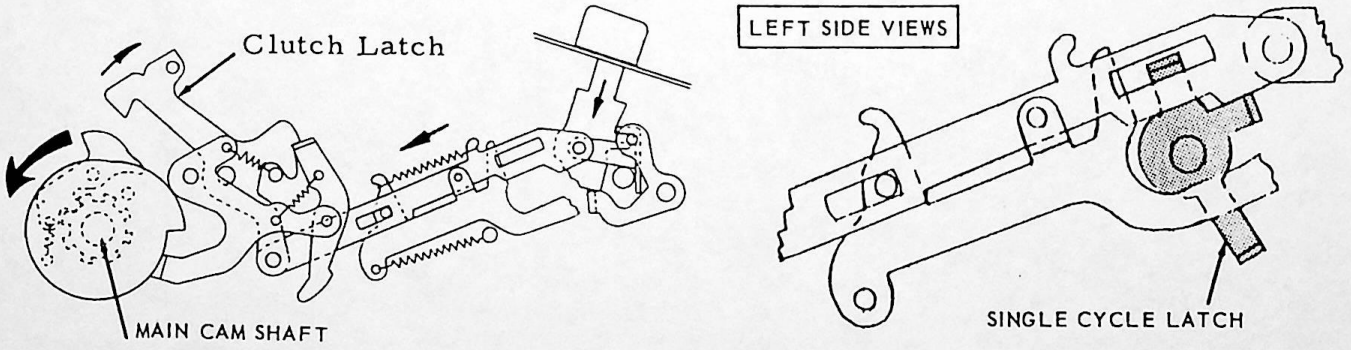
Clutch Ready to Trip - Keystem Partially Depressed

LEFT SIDE VIEW



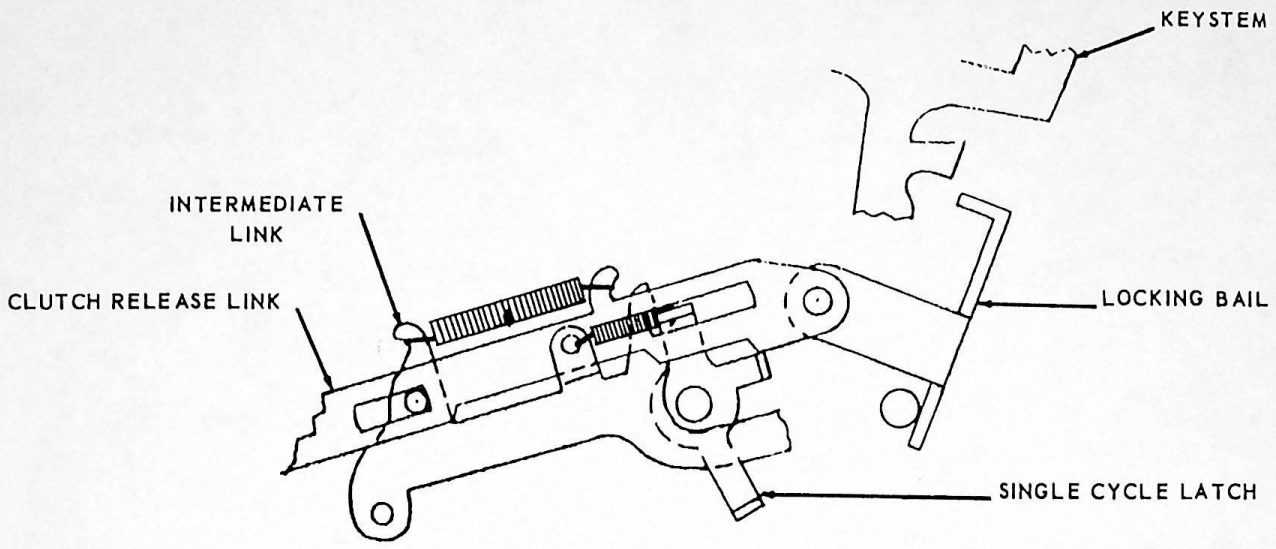
The intermediate link of the clutch release linkage is rearward, and the lug on the keystem blocks the rearward movement of the clutch release link.

Clutch Tripped - Keystem Fully Depressed



The locking bail positions over the top of the lug on the keystem, and the clutch release link moves rearward, raising the clutch latch. The main cam shaft begins its cycle.

Single Cycle Latch Normal Position



The Intermediate link of the clutch release bail positions the single cycle latch.,

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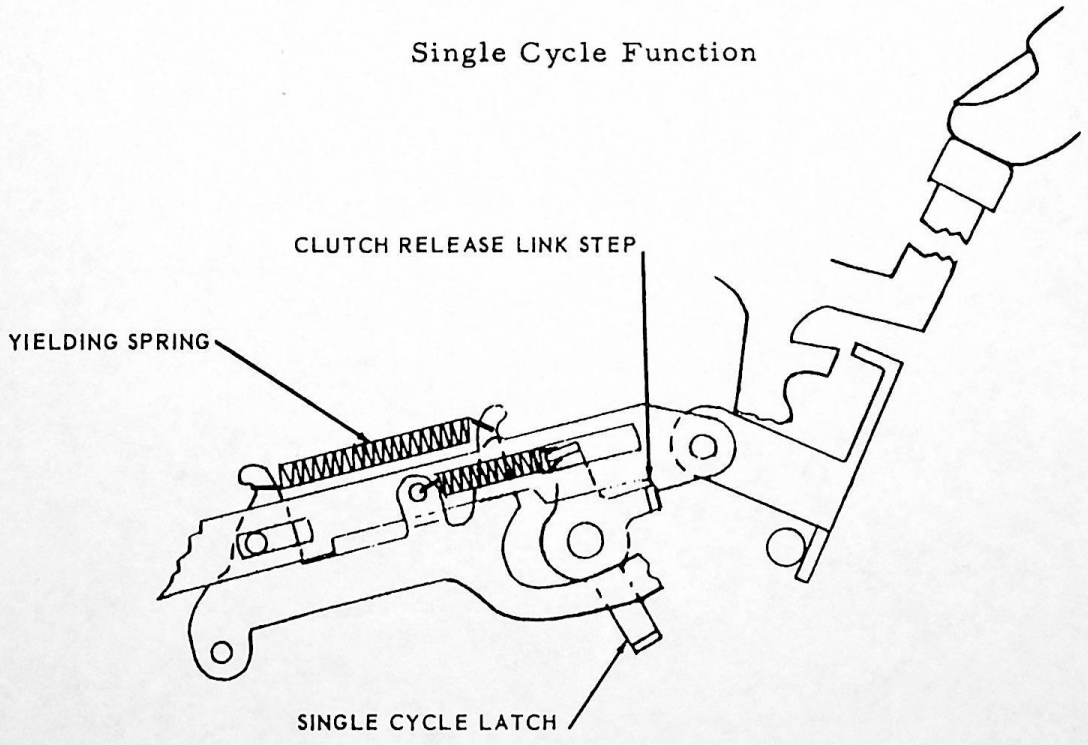
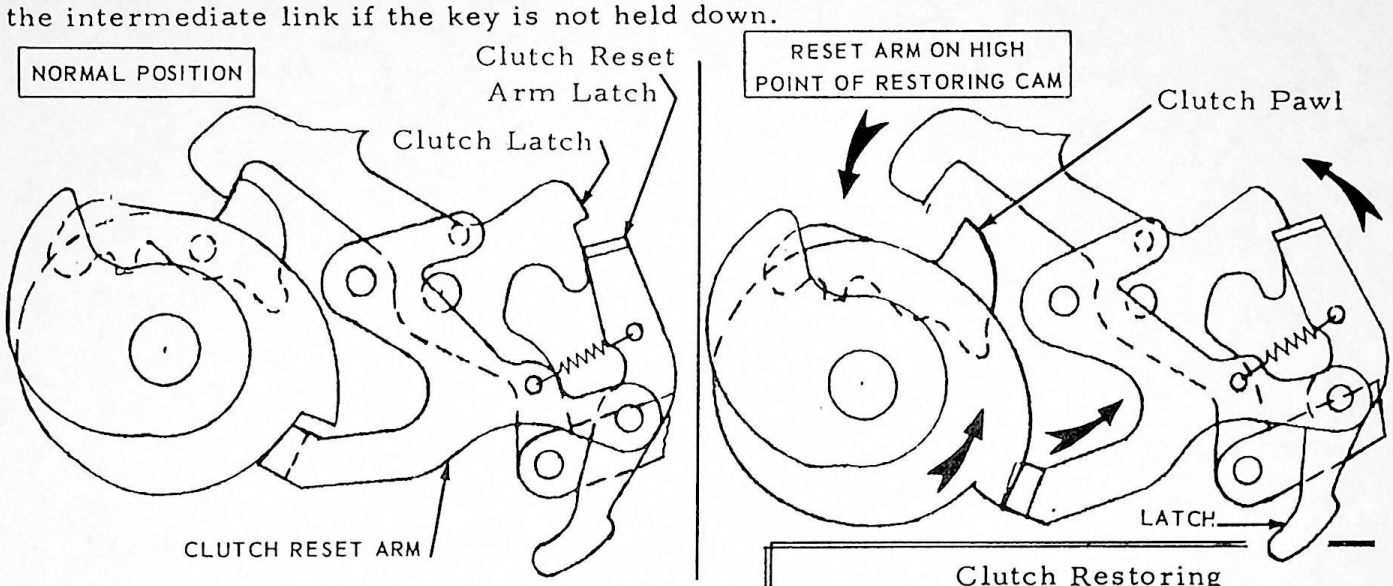
Single Cycle Function

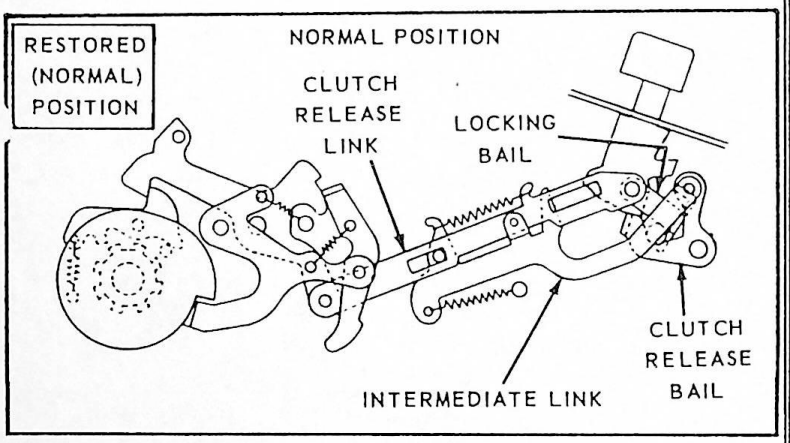


If the key is held depressed, until after the machine cycle is completed, the single cycle latch will engage the step on the clutch release link when the release link is restored at the end of the cycle. This prevents the release link from moving rearward and starting another cycle.

Clutch Restoring
(Function Key Released)

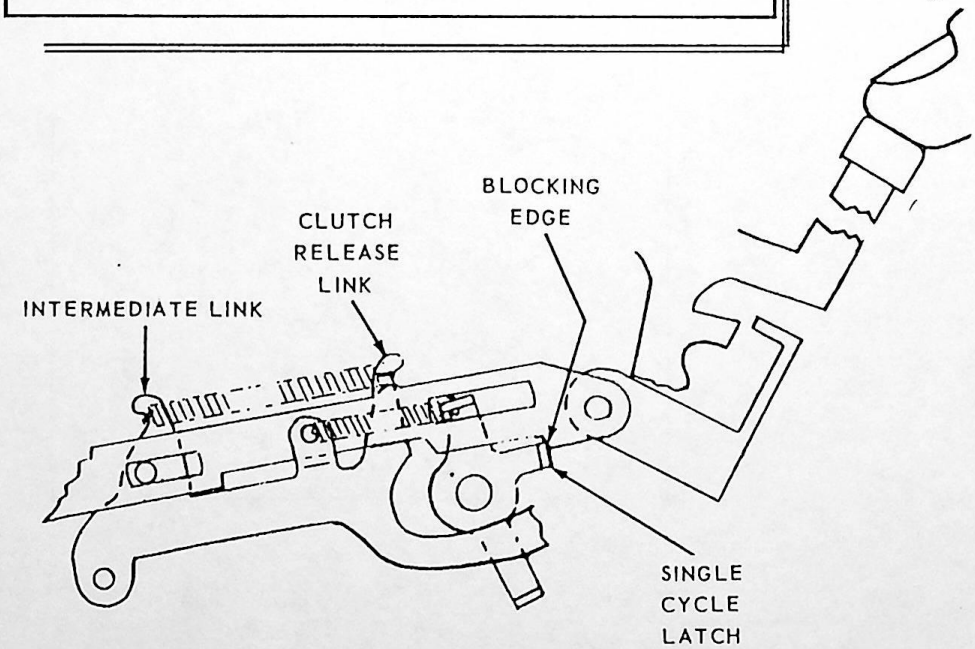
The clutch reset arm latch engages the upper end of the clutch latch rocking it down into the path of the clutch pawl. The lower end of the clutch latch operates the release link forward restoring the locking bail. The clutch release bail will be restored by the intermediate link if the key is not held down.

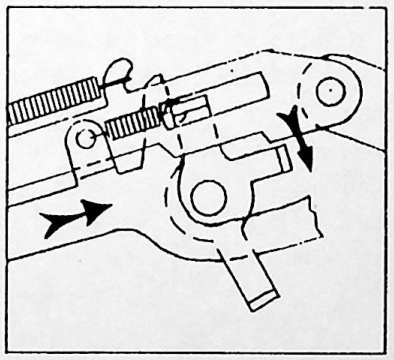




Clutch Restoring
(Function Key Held Down)

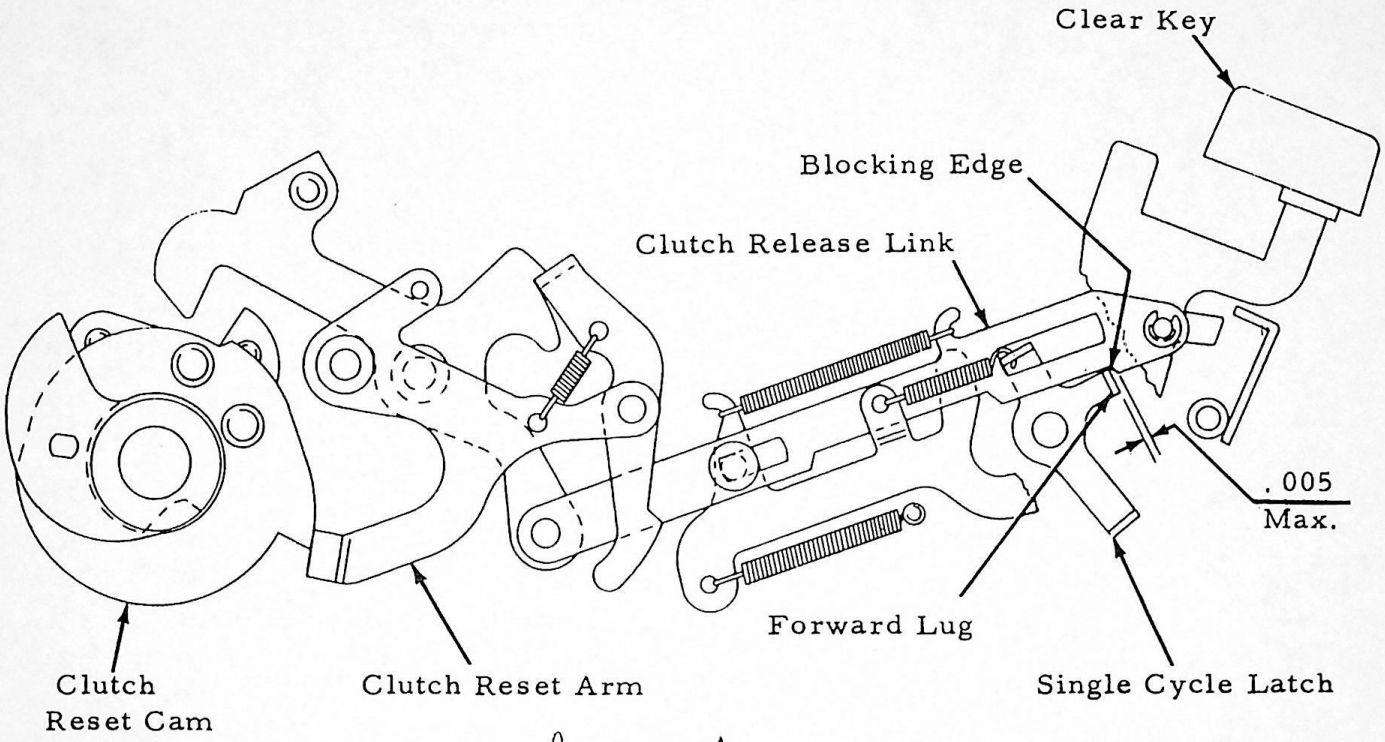
The clutch latch will restore even though a key is still held in the depressed position. The single cycle latch will engage the blocking edge of the clutch release link preventing it from going rearward until the key is released. When the depressed key is released the intermediate link moves forward and disengages the single cycle latch.





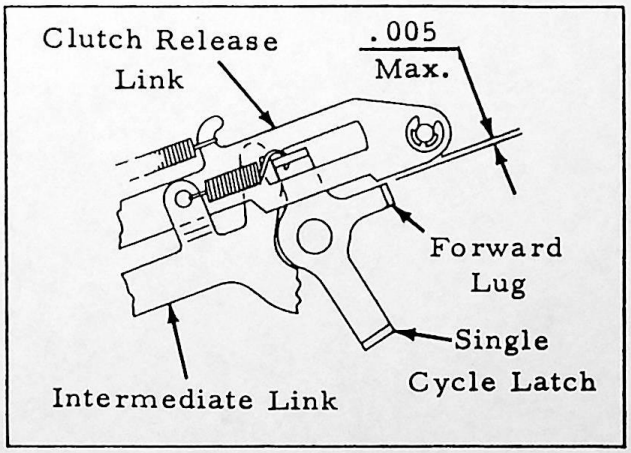
Single Cycle Latch Adjustment

1. Depress clear key and cycle machine with hand crank until clutch reset arm is on extreme high point of cam. Depress clear key again and check for slight latching clearance (.005 max.) between forward lug of single cycle latch and blocking edge of clutch release link....Form lug forward or rearward as required.



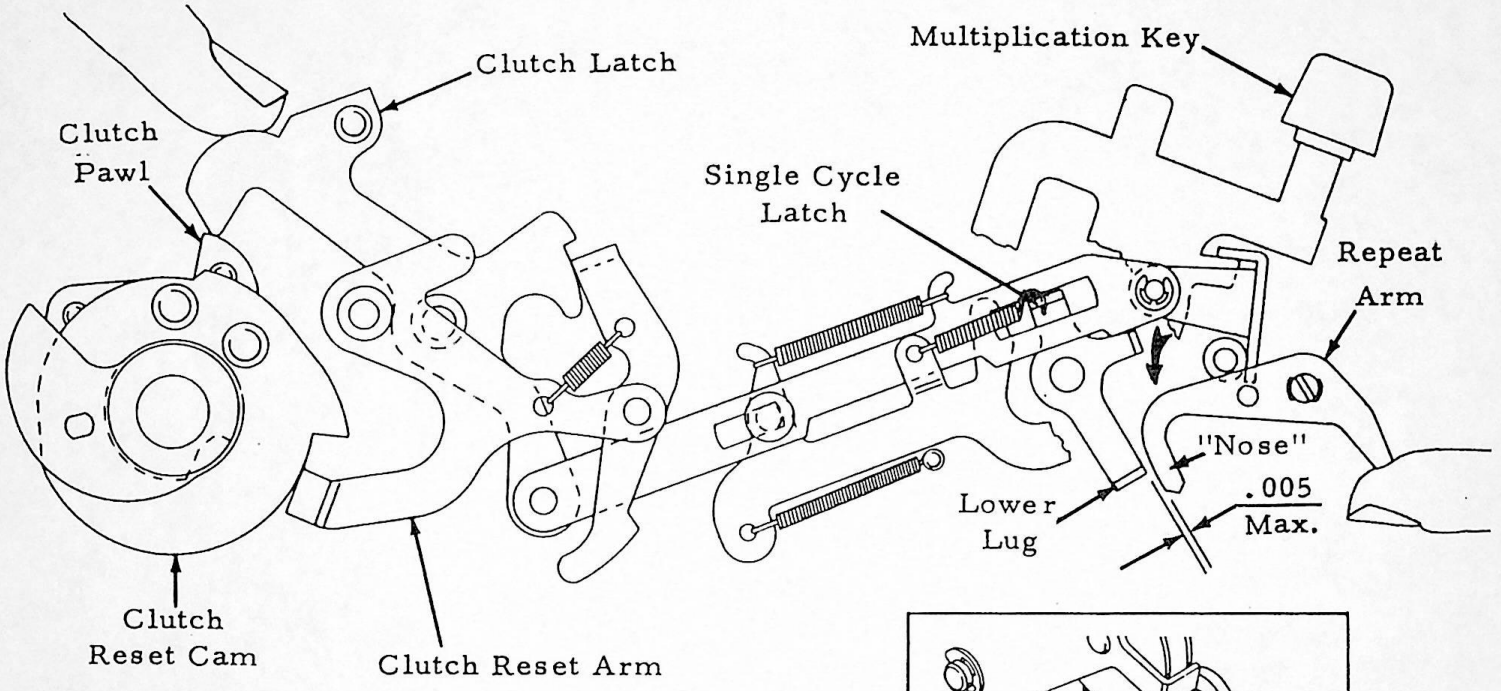
Improper adjustment can cause figures to be left in the register gears on a product total.

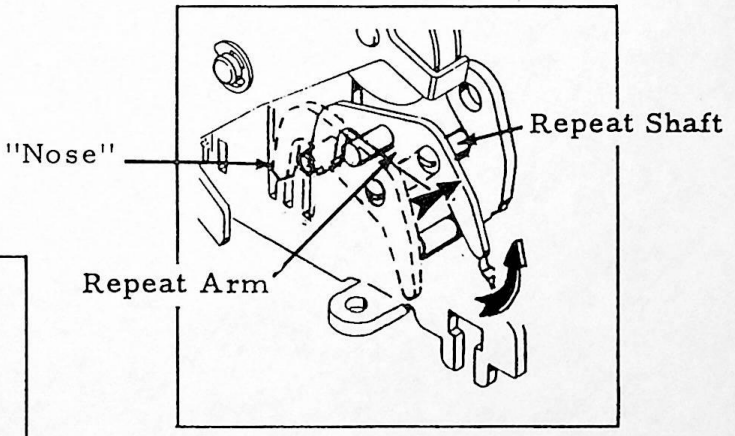
2. Neutralize machine so that single cycle latch is pivoted clockwise by (and rests against) the intermediate link. Check for slight neutral clearance (.005 max.) between top of forward lug of single cycle latch and lower edge of clutch release link....Form lug up or down as required.

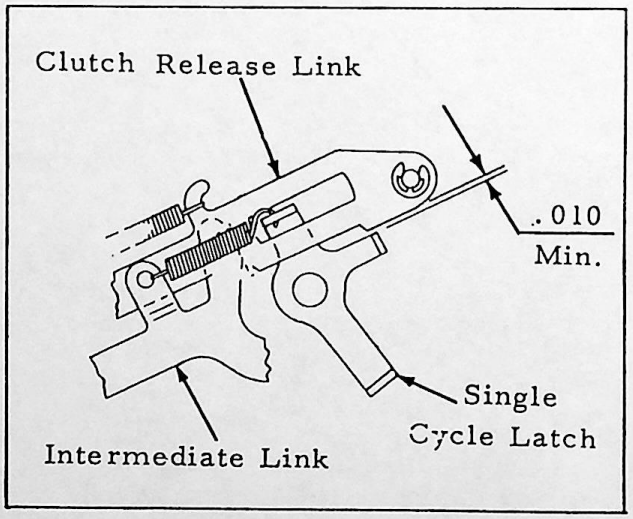


Single Cycle Latch Adjustment

3. Depress multiplication (=) key with nothing in set-up carriage, and cycle machine thru first cycle to point where clutch latch is directly over clutch pawl (start of second cycle). Push clutch latch down and hold it in contact with top of clutch pawl. Turn repeat arm counter-clockwise and push repeat shaft in. Check for slight clearance (.005 max.) between "nose" of repeat arm and lower lug of single cycle latch... Form lug forward or rearward as required.



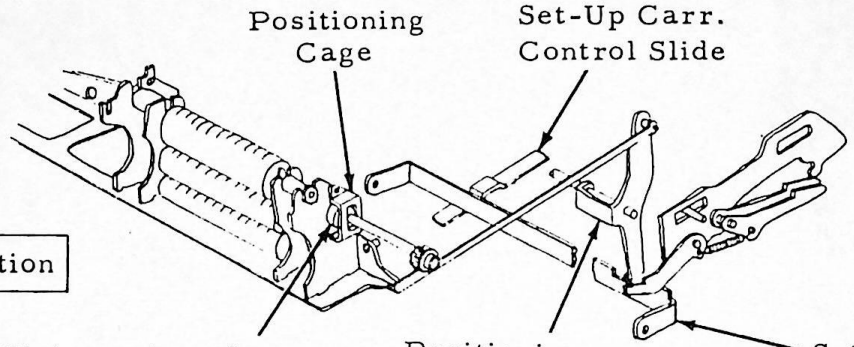




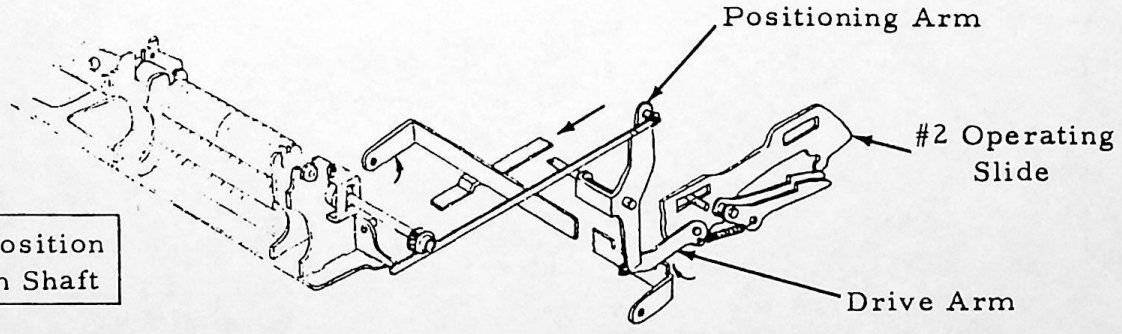
4. Neutralize machine and depress Plus Key together with Repeat Key... holding key down crank machine until clutch reset arm is on high point of cam. Check for a minimum horizontal clearance of .010 between top of forward lug of single cycle latch and lower edge of clutch release link... Refine adjustment #3 above as required.

Set-up Carriage Control

As the main shaft rotates, the program feed plate rocks the clear program bail. The clear program bail displaces four program slides: #4, set-up carriage engagement; #7, set-up carriage return; #12, non-print and #14, hold-up latch disabling.



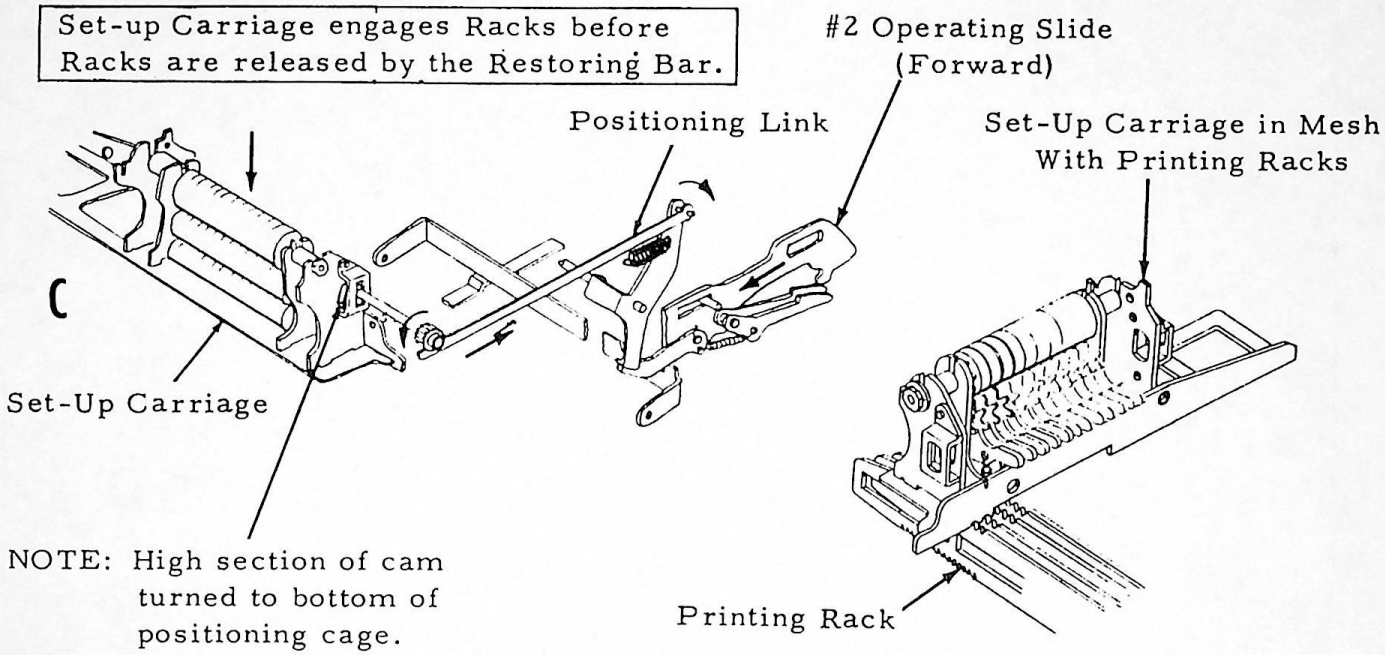
The set-up carriage engagement program slide (#4) operates the dec. key and numeral key lock and pivots its bell crank which pulls the set-up carriage control slide forward... raising the set-up carriage control bail. The set-up carriage control bail raises the drive arm on the #2 operating slide into alignment with the lower end of the set-up carriage positioning arm.

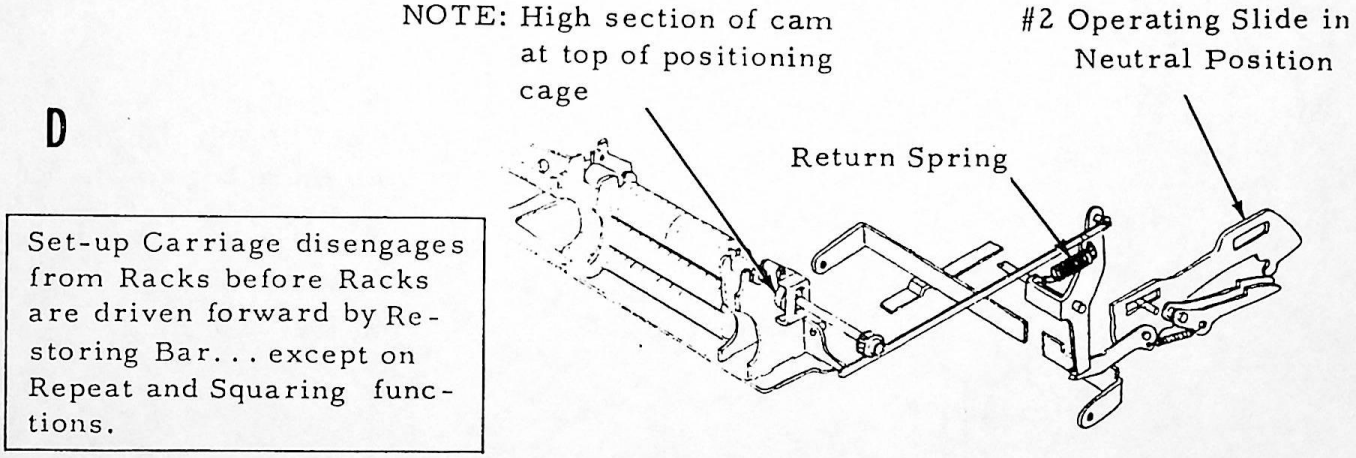


NOTE: The #2 Operating Slide Still In Its Normal Position

During its forward movement, the drive arm on the #2 operating slide rocks the positioning arm, moving the positioning link rearward. The positioning link rotates the shaft which carries the positioning cams (one each side of the set-up carriage), moving the set-up carriage down into mesh with the printing racks.

Set-up Carriage engages Racks before Racks are released by the Restoring Bar.


#2 Operating Slide (Forward)
Positioning Link
Set-Up Carriage in Mesh With Printing Racks
C
Set-Up Carriage
NOTE: High section of cam turned to bottom of positioning cage.
Printing Rack



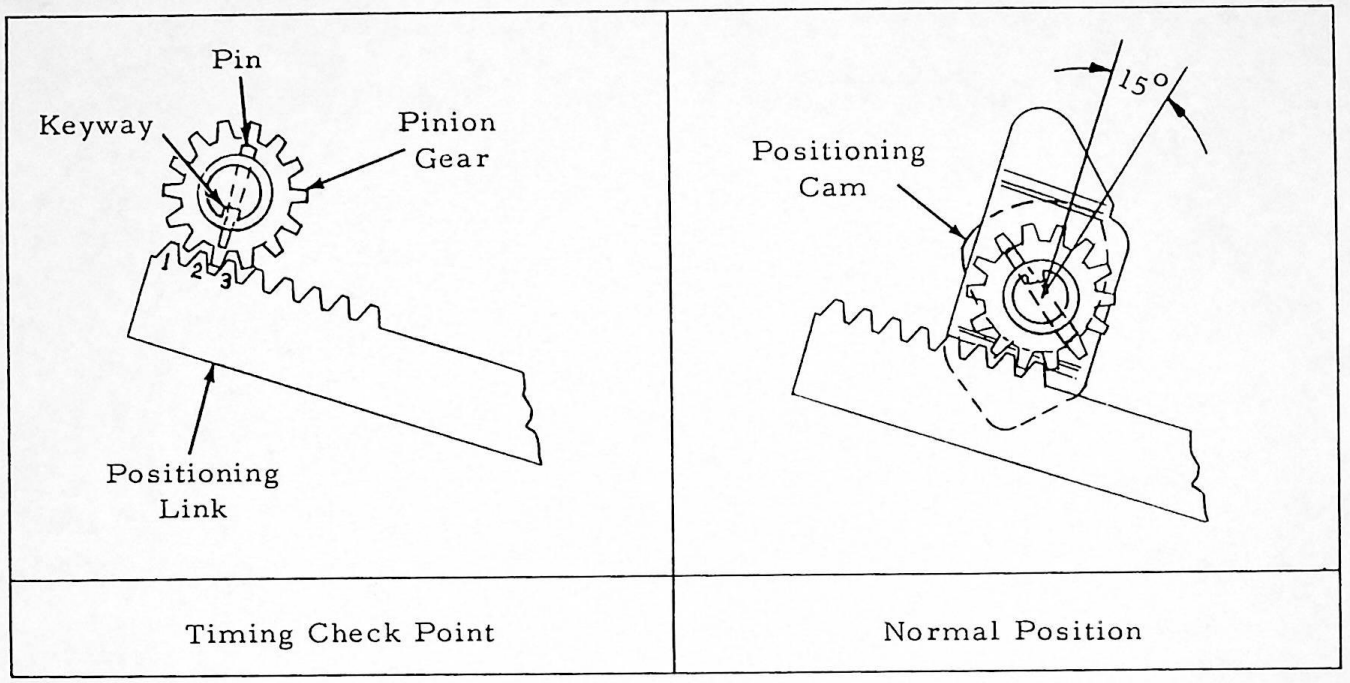
Set-up Carriage disengages from Racks before Racks are driven forward by Restoring Bar... except on Repeat and Squaring functions.

After the printing racks have moved rearward and to the aligned position, the #2 operating slide moves rearward (neutral position), the spring returns the positioning link forward. The positioning shaft rotates the positioning cams, moving the set-up carriage up out of mesh with the printing racks.

On Repeat and Squaring functions, the sub-total cam (as well as the total cam) is positioned to engage the cam follower which drives the #2 operating slide. This causes the #2 operating slide to remain in its forward position... keeping the set-up carriage in mesh...as the racks are driven forward to neutral by the restoring bar. The amount is thereby re-entered in set-up carriage. The #2 operating slide is neutralized by the sub-total cam near the end of the cycle... disengaging the set-up carriage.

Timing

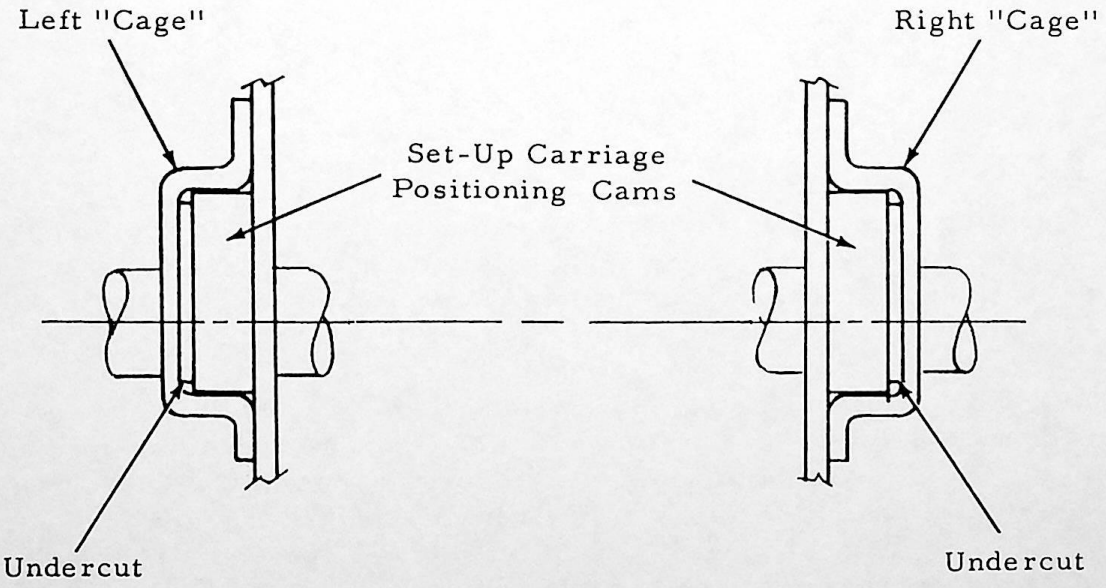
Engage teeth of positioning link with pinion gear so that pin and keyway of pinion gear align with gap between 2nd and 3rd tooth of link as shown in check point drawing.



Timing Check Point | Normal Position

Note: When properly timed, the Set-Up Carriage will dwell in it's "Up" position for approximately the first 15° of positioning cam rotation.

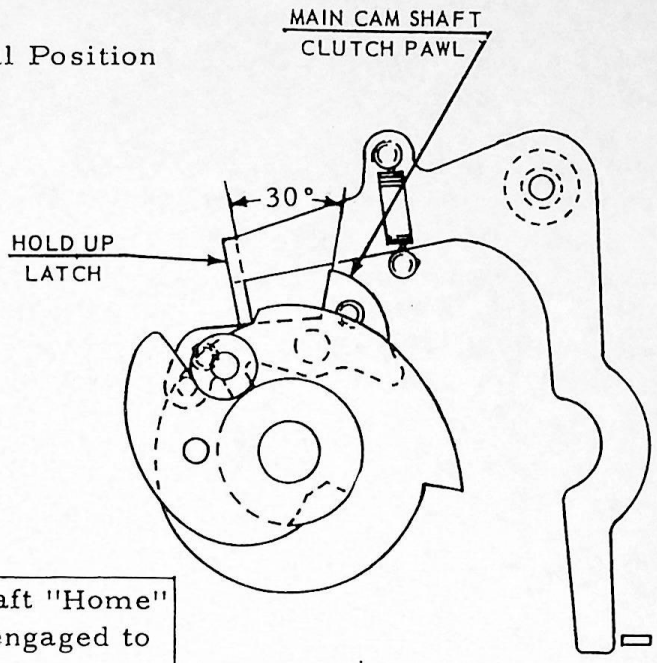
NOTE: The two set-up carriage positioning cams are interchangeable....However, when installing these cams, the undercut sides must be positioned to the outside of the positioning "cages". This will prevent a bind between the sharp edge of the cam and the inside radius on the forming of the cages.



DISABLING THE HOLD-UP MECHANISM

Normal Position

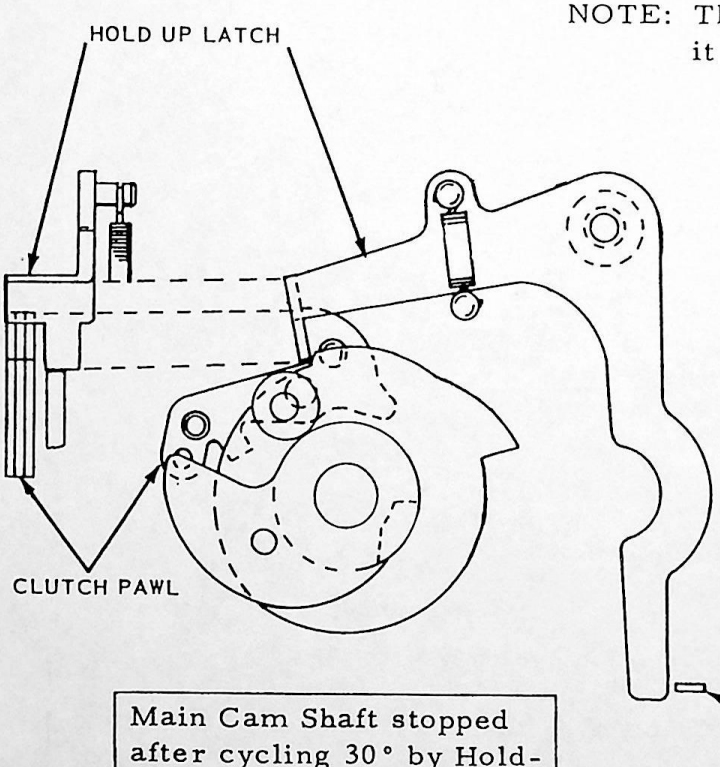
A mechanism has been provided to interrupt the main shaft cycle after approximately 30° of rotation. This mechanism is called the "hold-up" mechanism. The primary part involved is called the hold-up latch. Its function is to engage the main cam shaft clutch pawl thereby disengaging the clutch.



Main Cam Shaft "Home" Clutch Pawl engaged to start cycle.

Hold-Up Position

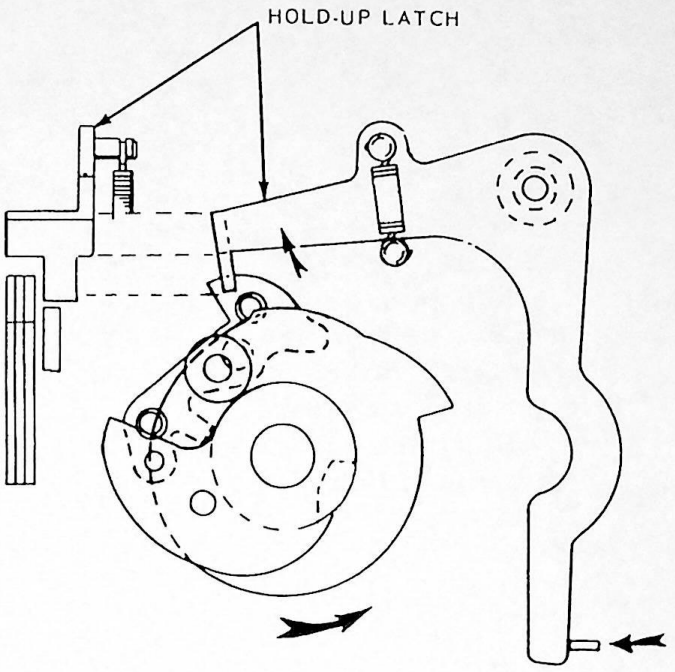
NOTE: This position is shown for reference ... it does not occur on a clear key function.



There are several reasons why it is necessary to interrupt the main shaft cycle during certain operations. These reasons will be discussed later when covering such operations. However, during the clear key operation it is not necessary to interrupt the main shaft cycle. Therefore the hold-up latch must be disabled.

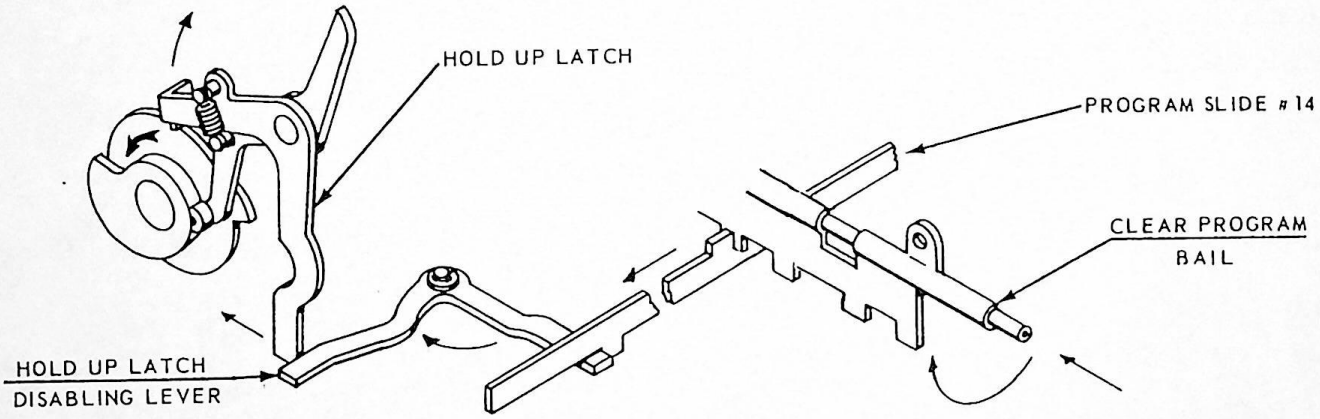
Main Cam Shaft stopped after cycling 30° by Hold-up Latch disengaging the Clutch Pawl.

Hold-Up Latch Disabled



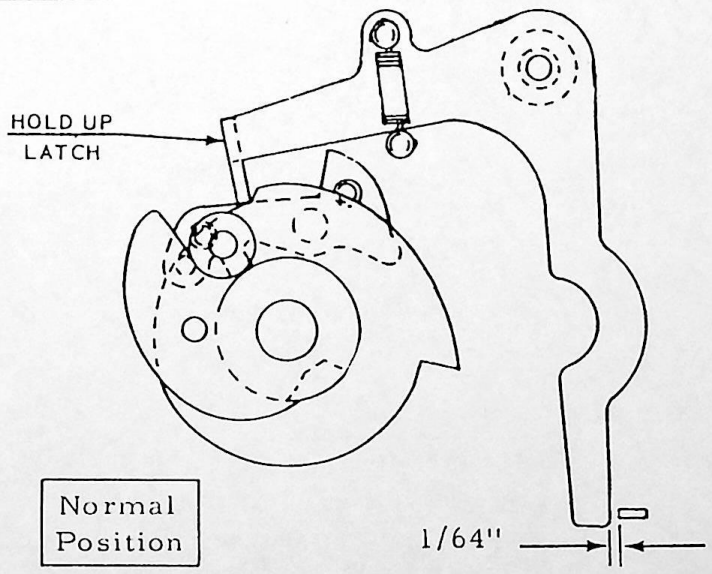
This is accomplished by the hold-up latch disabling lever which is operated by the hold-up latch disabling program slide (#14). The program slide of course, is operated by the clear program bail. Program slide #14 is also operated by: the non-add, total and sub-total program bails ... on transfer dividend by the enter dividend program bail ... and ... on the remainder cycle of automatic division operations by the division program cam shaft.

Main Cam Shaft is not stopped after 30° cycle when Hold-up Latch Disabling Lever is operated.



Adjustment

1. 1/64" max. clearance in neutral position. Form disabling lever as required.
2. Check for release clearance between hold-up latch and clutch pawl on clear, non add, total, sub-total and enter dividend function.



Normal Position

RACKS AND ALIGNER

There are two sets of racks, the front racks and the rear racks. One front and one rear rack are used in each column. They are coupled together and move as one. The front racks are spaced .125 (1/8") apart; the same as the set up dials and type wheels.

The rear racks are spaced .208 (almost 7/32") apart; the same as the accumulator, register, selector and multiplier/quotient gears. They have offset arms through which they are coupled to the front racks.

The rear set of racks have teeth on top to mesh with the register gears, selector and multiplier/quotient gears. There are also bottom teeth which mesh with the accumulator gears.

The front set of racks have teeth on top to mesh with the set-up carriage gears and printing wheel gears, and a set of ratchet teeth on the bottom which the aligner pawls engage.

Rack alignment is obtained by a group of pawls which, when engaged, prevent the racks from moving rearward, but permit them to move forward with a ratchet action.

When the machine cycles, the rack restoring bar moves rearward and the racks follow by spring tension until they are stopped.

In the clear function, as in any function in which the set-up carriage is engaged, the racks are stopped by the set-up carriage gears when the gears have been rotated to their zero stop position. In columns to the left and right of the set-up carriage gears, the racks are stopped by the zero bail of the set-up carriage.

The aligner pawls now move into engagement with the ratchet teeth and align the racks so that the various registers* can move in and out of mesh with the racks. The aligner pawls stay engaged with the racks until the racks are returned home... then the pawls disengage.
NOTE: The printing wheels never disengage from the racks.

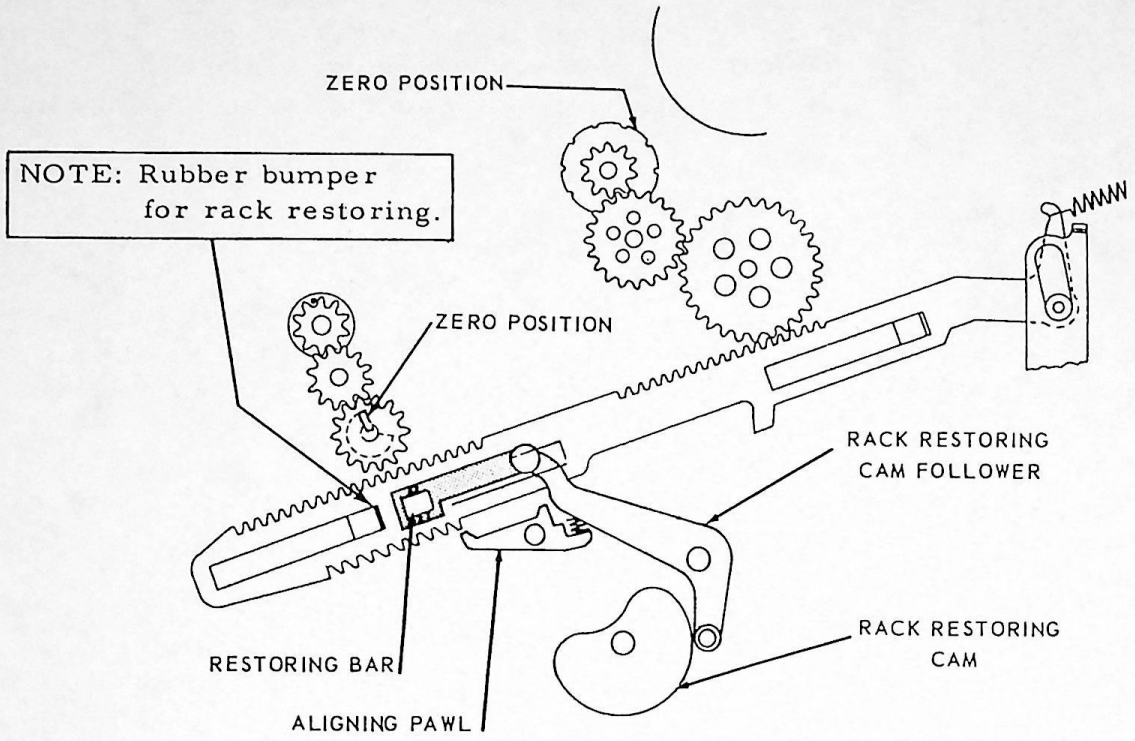
On totaling out, a register is in mesh with the racks during the rearward movement of the racks. (Rack spring tension). (One exception to this is the selector which is cleared by a separate set of gears).

On the forward movement of the racks (return power stroke) the amounts are put in the various registers.

On the squaring, repeat and sub-total functions, the registers do not disengage from the racks when they have been cleared to zero. They come out of mesh at the end of the return (power stroke) of the racks after the amounts that were removed have been re-entered.
There are 23 printing racks (front racks). The first two on the right side are for symbol printing and are not coupled to the rear racks.

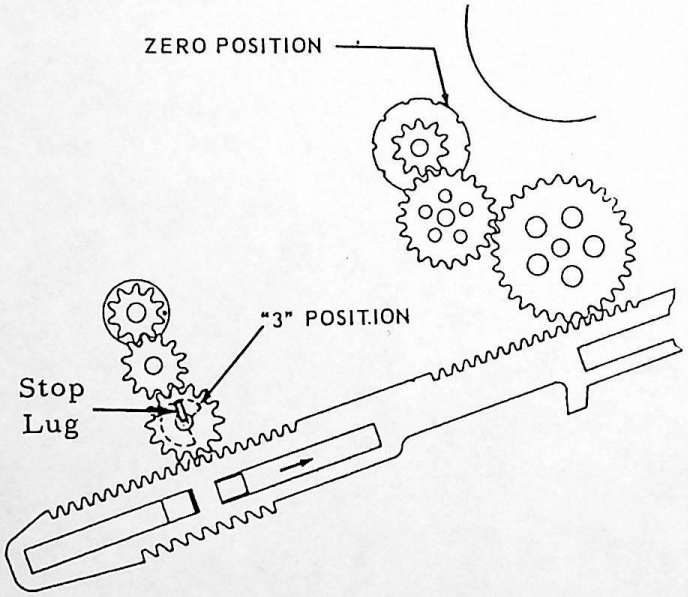
*NOTE: The term "register", as used in this text, applies to any of the various storage gear units. These units include the set-up carriage, accumulator, register, selector and multiplier/quotient gears.

Set-Up Carriage and Printing Wheel in Normal Position'

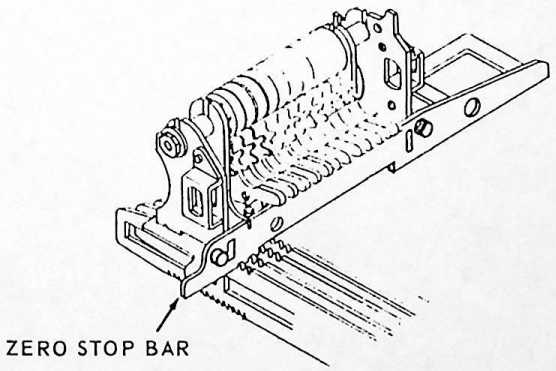


The rack is held in forward position by the restoring bar. This is the aligned position for the meshing of the set-up gear with the rack. The aligning pawls do not function for the meshing of the set-up carriage with the racks.

'3' In Set-Up Carriage and Set-Up Carriage in Mesh With Racks

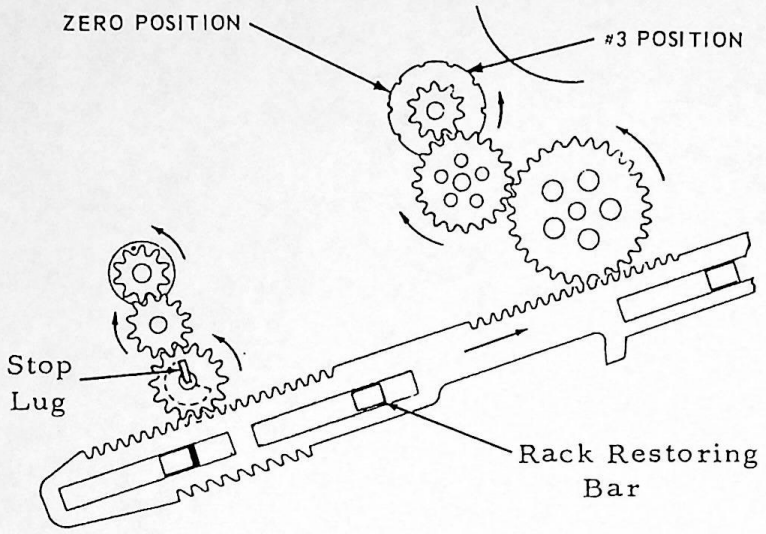


Set-up gear at 3 and in mesh with the rack and printing wheel at zero printing position.
Note the position of the internal stop cam of the set-up gear to the stop lug on the stop bar.

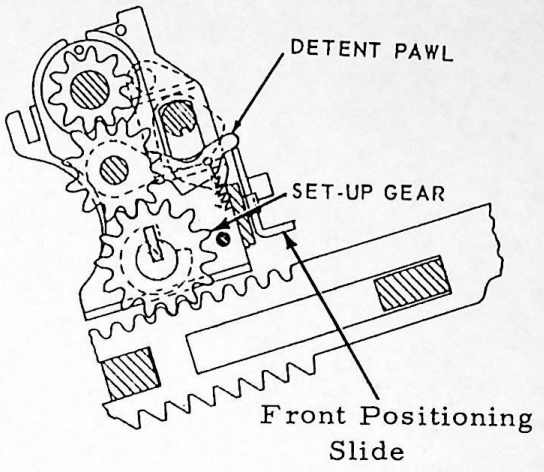


The zero stop bar of the set-up carriage, when in mesh with the racks, holds the racks to the left and right of the set-up gears at their zero position.

Transfer From Set-Up Carriage To Printing Wheel

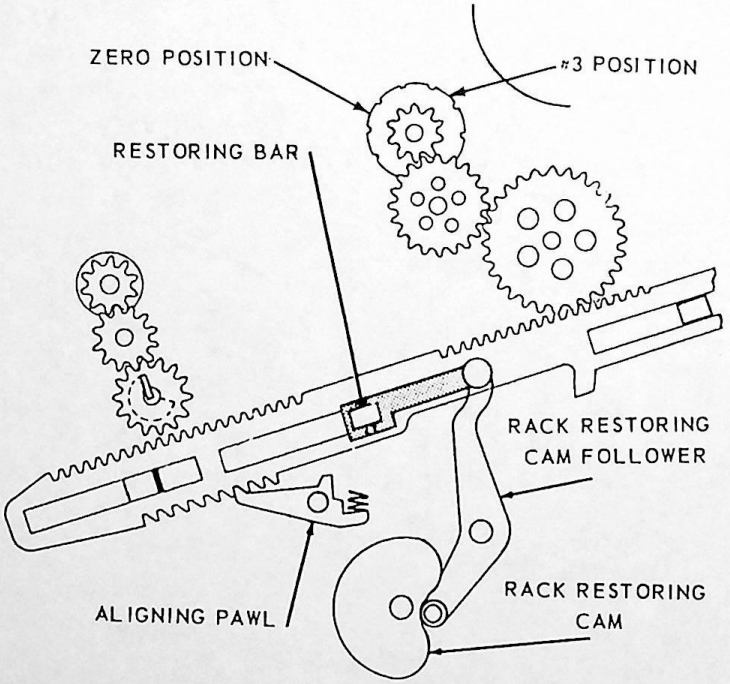


Rack restoring bar moved rearward allowing rack to move rearward until stopped by the stop lug. The set-up carriage will not disengage from the racks until the aligner pawls engage the racks.



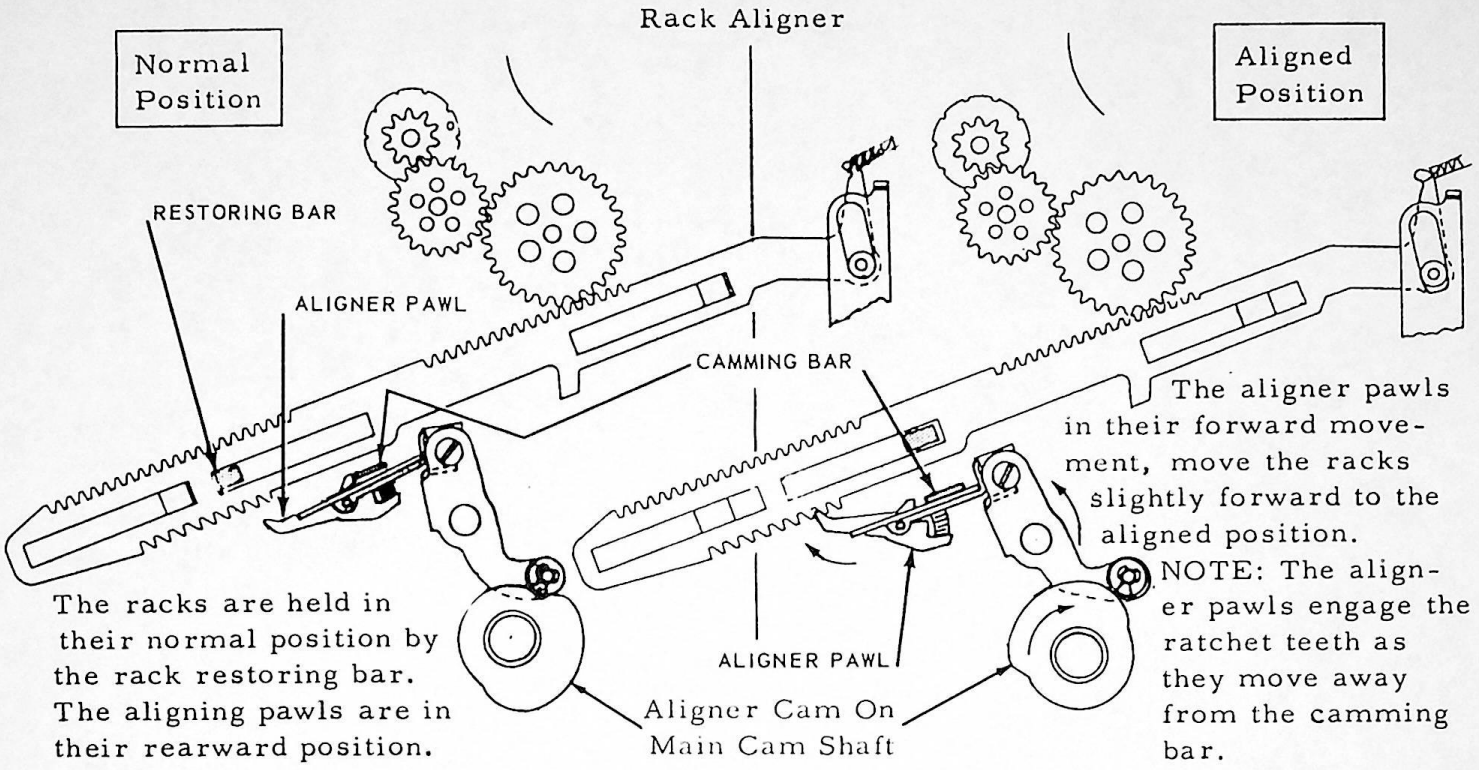
NOTE: The detent pawls for the set-up gears are disengaged from the gears when the set-up carriage moves down into mesh with the racks by their tails contacting the front positioning slide.

Aligned Position - Set-Up Carriage Disengaged



The set-up gear is at zero and the printing wheel is at 3.

NOTE: The aligning pawl engages, aligns and moves racks forward slightly (to relieve load from set-up carriage). The printing wheel is restored to zero when the rack is returned forward by the restoring bar, leaving the set-up gear at the zero position.



The racks are held in their normal position by the rack restoring bar. The aligning pawls are in their rearward position.

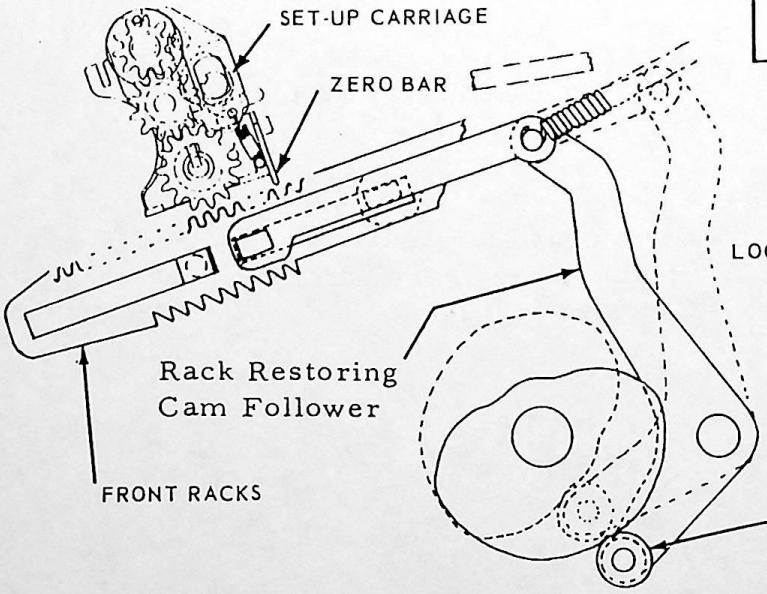
The aligner pawls in their forward movement, move the racks slightly forward to the aligned position.

NOTE: The aligner pawls engage the ratchet teeth as they move away from the camming bar.

Adjustment

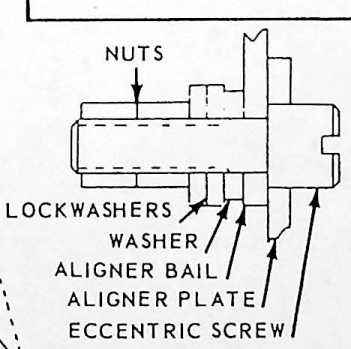
1. Neutral Position

Manually position the set-up carriage into engagement with the racks by the positioning arm. The zero bar should enter the racks without displacing them in either direction, check with the set-up carriage in both the right and left hand positions. Change the rack restoring cam follower roller to adjust the neutral position of the racks.



2. Aligned Position

Depress the clear key and cycle the machine until the aligner pawls are fully engaged and the set-up carriage releases from the racks. Manually position the set-up carriage in and out of the racks with the positioning arm. The zero bar should enter the racks without displacing them or cramping. Turn the adjusting screws clockwise only until this condition is achieved.



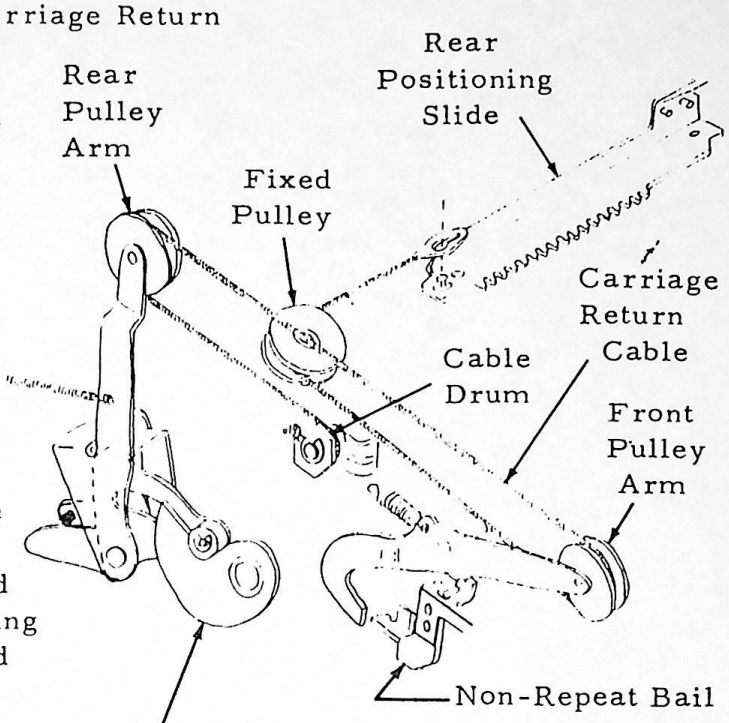
39G

See page 20-4 of Parts Catalog for chart of roller sizes.

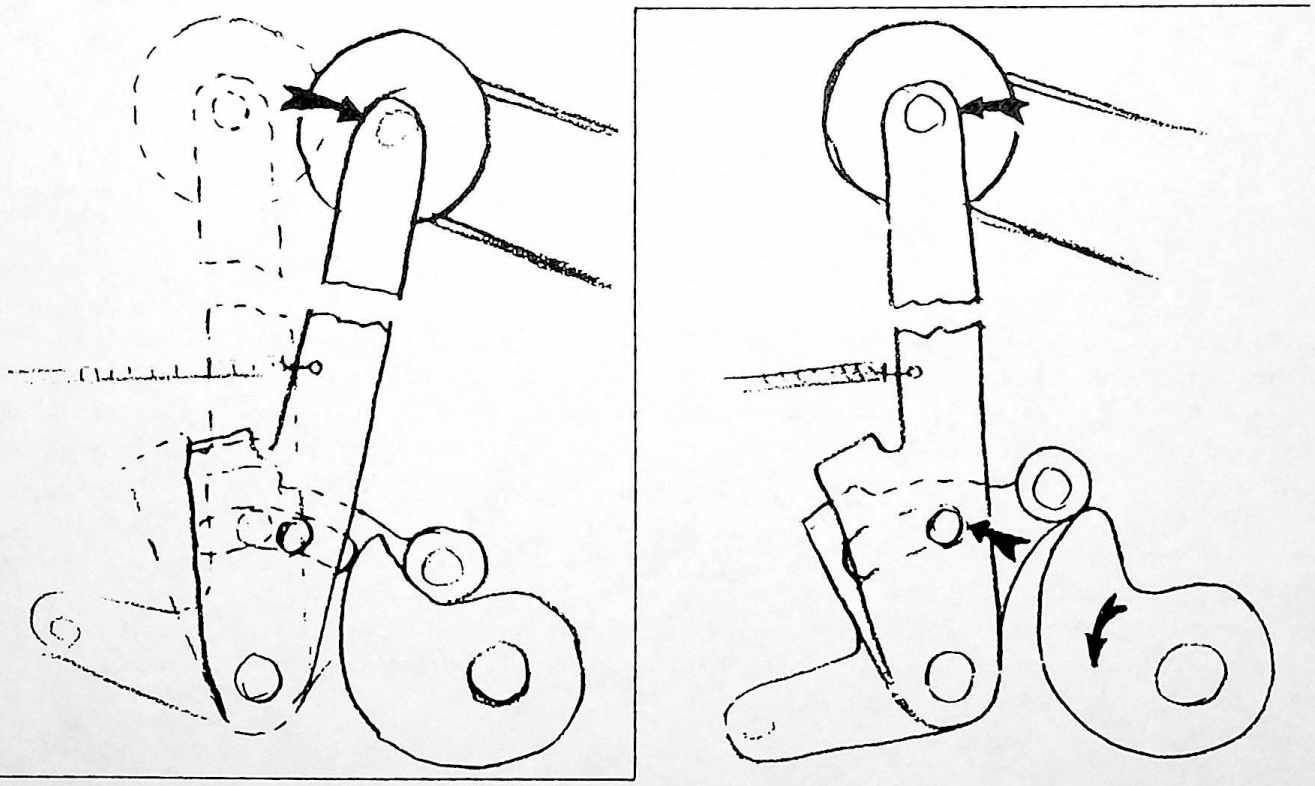
Set-Up Carriage Return

One end of the carriage return cable is attached to the left end of the rear positioning slide.... The other end is wound around and secured to the cable drum. Between the two ends, the cable winds around three pulleys; one fixed and two on moveable pulley arms.

Any escapement of the set-up carriage to the left causes the rear positioning slide to move to the right... pulling the cable. Since the other end of the cable is anchored, pulling the cable causes the rear pulley arm to pivot forward. (The front pulley arm is not pivoted rearward since it is restrained by a stronger spring than the comparatively weak spring used on the rear pulley arm).



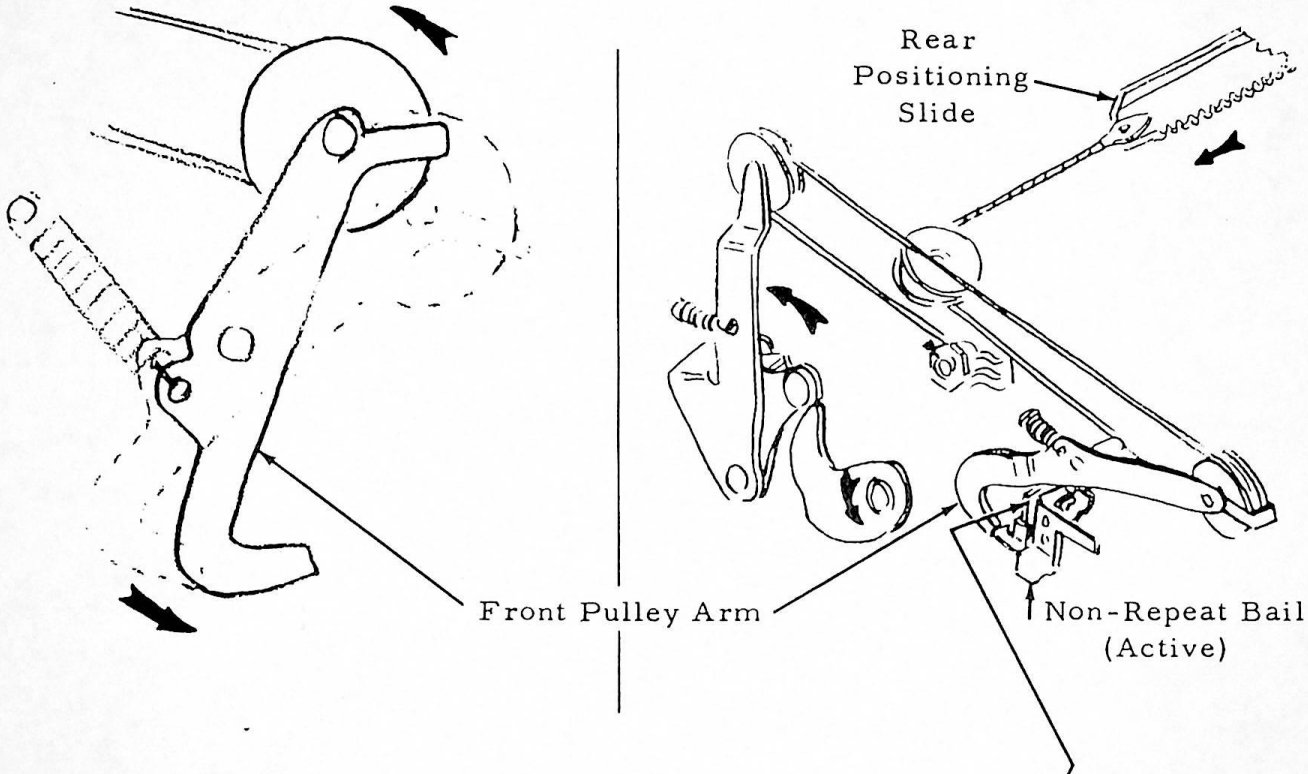
The set-up carriage return and platen space cam is located on the extreme left end of the main cam shaft. Its cam follower is connected to the rear pulley arm thru a slot/stud arrangement. This permits the stud of the pulley arm to move forward in the slot of the cam follower whenever the set-up carriage is escaping to the left.



On the second half of a machine cycle (when the set-up carriage would normally be released from mesh with the racks) the carriage return and platen space cam drives its cam follower to the rear. The end of the slot in the cam follower contacts the stud of the rear pulley arm... pivoting the pulley arm to the rear. This again pulls the cable.

Now the spring for the front pulley arm, while stronger than the one for the rear pulley arm, is not nearly as strong as those holding the set-up carriage to the left. Therefore, the action of the carriage return cam would simply cause the front pulley arm to be pivoted rearward and the set-up carriage would remain in its escaped position ... if the set-up carriage return program slide (#7) had not been selected.

Front Pulley Arm is Pivoted When Carriage Return Program is Not Selected.	Rear Positioning Slide is Pulled to the left when Carriage Return Program is Selected.



On the program feed stroke the set-up carriage return program slide (#7) is driven to the left.... The left end of the program slide contacts the lug on the lower arm of the non-repeat bail... pivoting the bail into active position. In active position, the lower arm of the non-repeat bail locates directly in the path of the lower extension of the front pulley arm where it prevents the front pulley arm from pivoting rearward.

Thus... when the carriage return cam drives the rear pulley arm to the rear ... and the front pulley arm is blocked by the non-repeat bail... the resulting pull on the cable pulls the rear positioning slide to the left which returns the set-up carriage to the right to its "home" position.

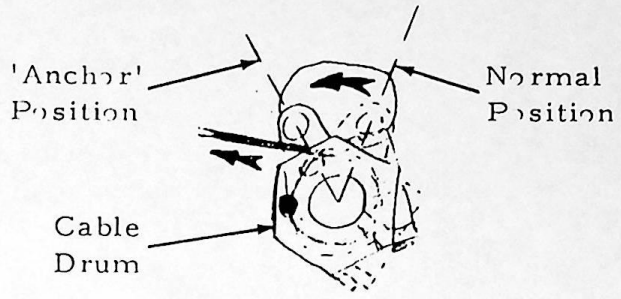
Decimal Bail Latch Release Arm

It was mentioned previously that one end of the carriage return cable is wound around and secured to the cable drum...and this end is anchored. Actually, there is a short pivoting movement of the cable drum before it is stopped in its "anchor" position.

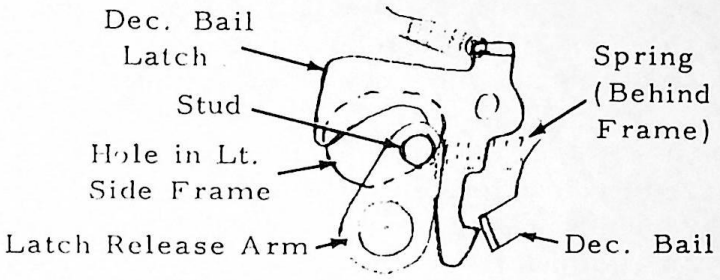
The decimal bail latch release arm is clamped to the cable drum. A stud on the release arm projects thru a hole in the left side frame. The pivoting movement of the release arm and cable drum is limited by the stud contacting the sides of the hole.

In normal position, the release arm cable drum assembly is held pivoted in a clockwise direction (as viewed from the left side) by a spring attached to the stud of the release arm. In this position, the decimal bail latch is free to engage the decimal bail whenever the decimal bail is activated by a function key. (When the decimal bail is pivoted by a function key, the rear lug of the decimal bail is engaged by the latch which is pivoted by the latch spring).

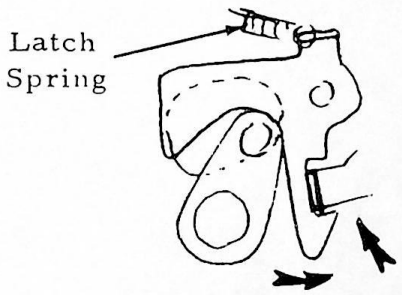
On a carriage return operation (when the front pulley arm is blocked by the non-repeat bail)...the first movement of the cable (before the rear positioning slide is moved) causes the cable drum to pivot in a counter-clockwise direction....The stud of the release arm contacts the tail of the decimal bail latch...pivoting the latch out of engagement with the decimal bail* (which is then returned to normal by its spring). The stud then contacts the rear wall of the hole in the side frame which stops the pivoting movement of the cable drum and provides the anchor position from which the cable returns the set-up carriage to its home position.



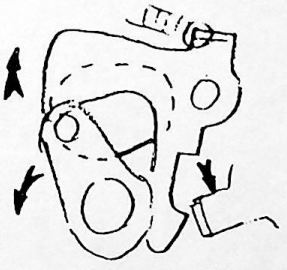
Cable Drum Positions



Dec. Bail Unlatched



Dec. Bail Latched



Dec. Bail Released

*NOTE: The decimal bail would not normally be latched during the "clear" function...unless it had been previously latched on a repeat plus or repeat minus function...or by depression of the decimal bar.

Set-Up Carriage Return Cable Adjustment

The amount of return movement imparted to the set-up carriage is adjustable by loosening the clamp screw on the decimal bail latch release arm...and turning the cable drum, in relation to the clamp, to wind more...or less...of the cable around the drum.

With the set-up carriage in "home" position (ratchet latched on escapement pawl as shown in "normal position" drawing...page III-C-5)...grasp the cable just in front of the fixed pulley and pull forward....Note that the set-up carriage moves about 1/16" to the right. This is the "overtravel" distance available for the set-up carriage return cable adjustment.

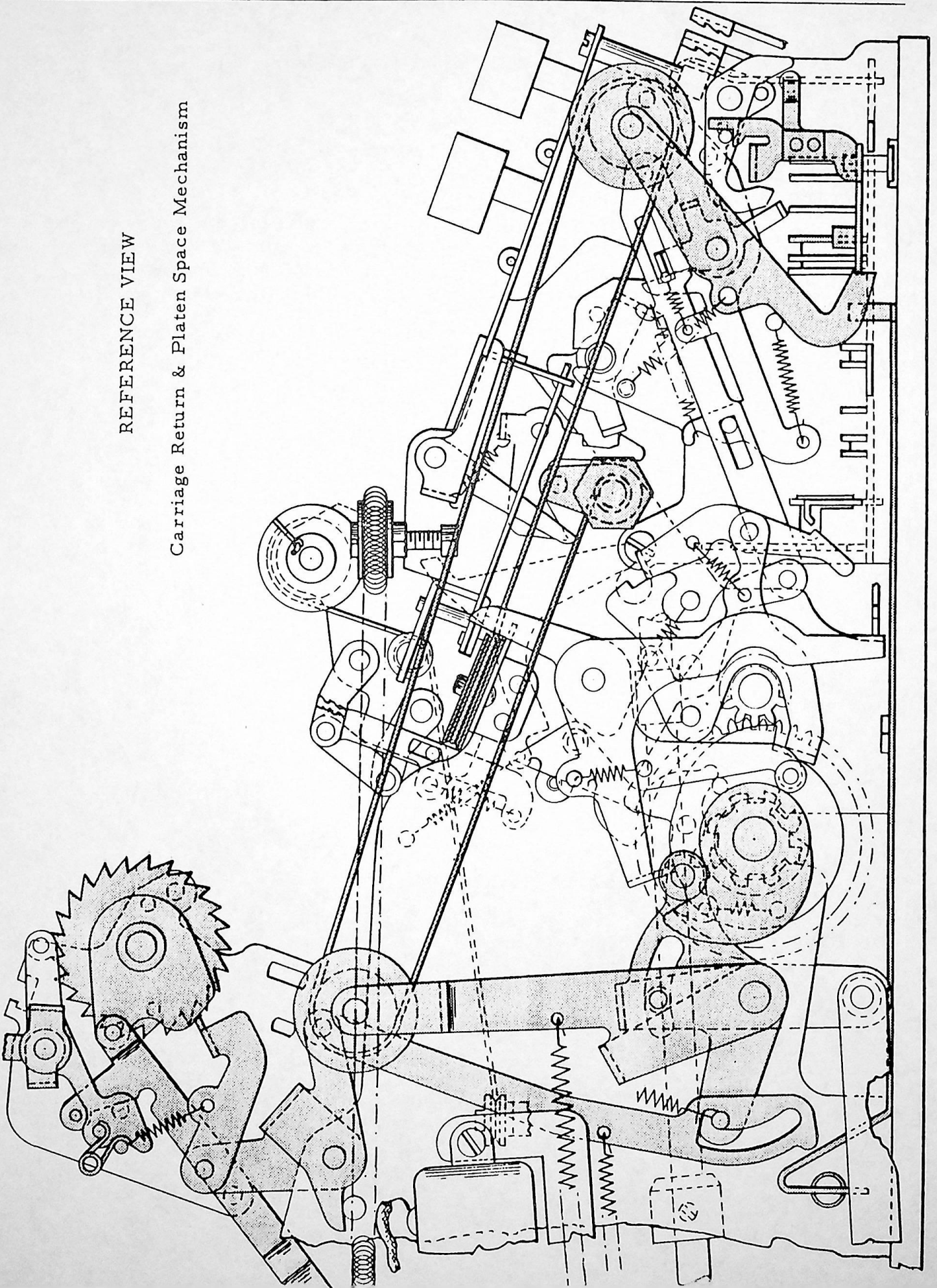
On a set-up carriage return operation, the set-up carriage should return to the right approximately 1/32" past the point where the ratchet is latched by the escapement pawl in the "home" position...when the carriage return/platen space cam follower is on the high point of the cam...and machine is being operated with the hand crank. This will leave about half of the available "overtravel" distance unused...and prevent undue stress on the cable.

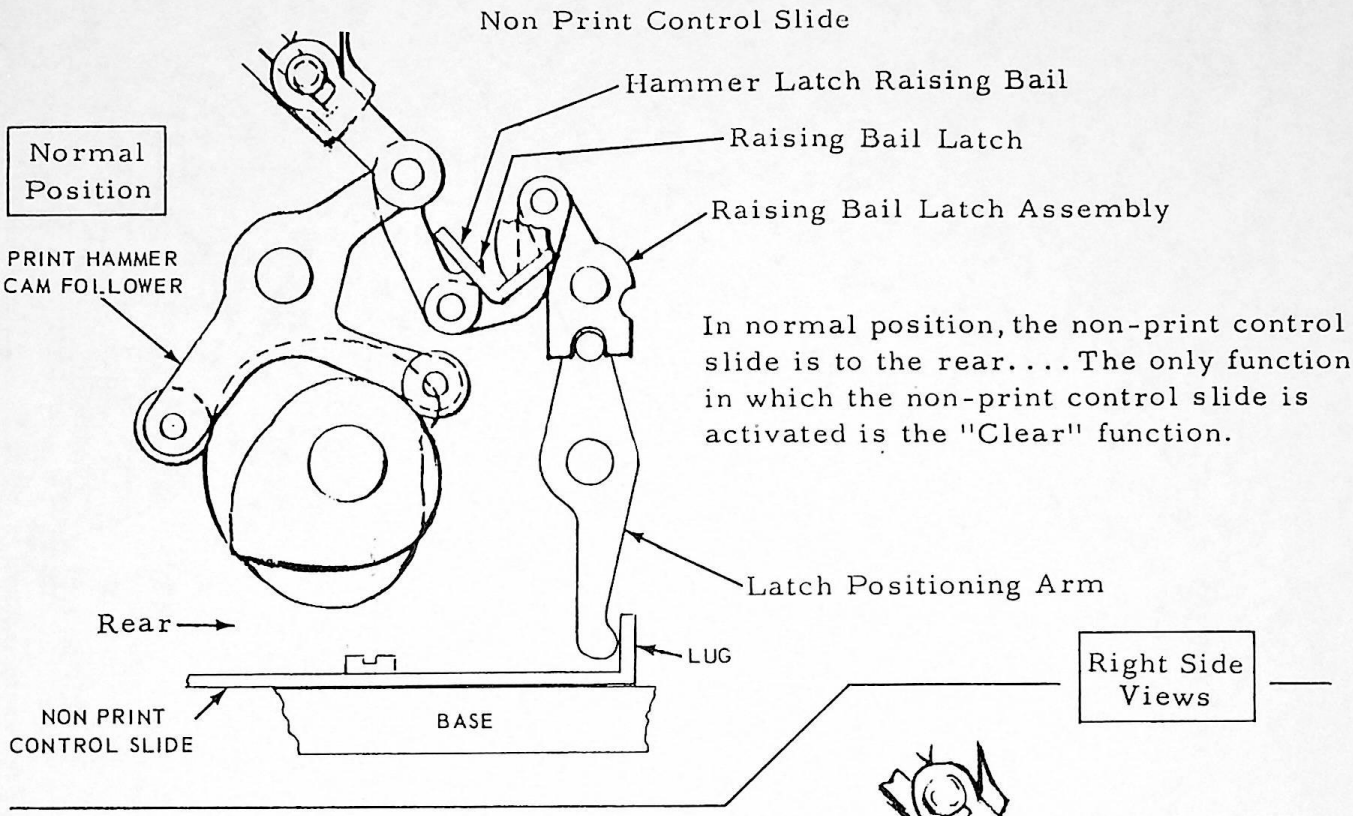
Adjust clamp on cable drum as required...

NOTES

REFERENCE VIEW

Carriage Return & Platen Space Mechanism

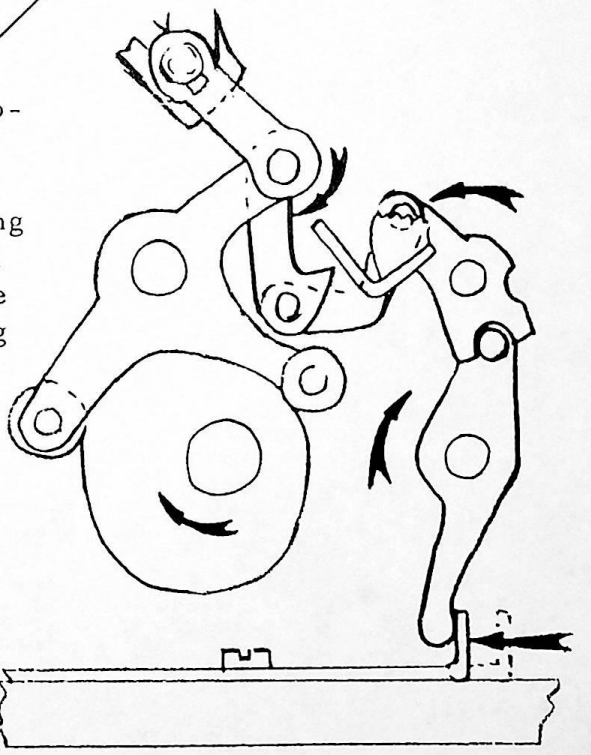


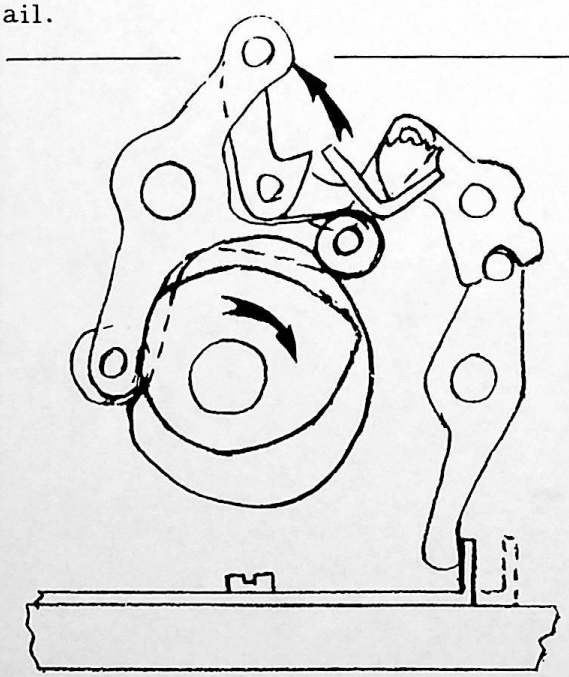


In normal position, the non-print control slide is to the rear.... The only function in which the non-print control slide is activated is the "Clear" function.

Right Side Views

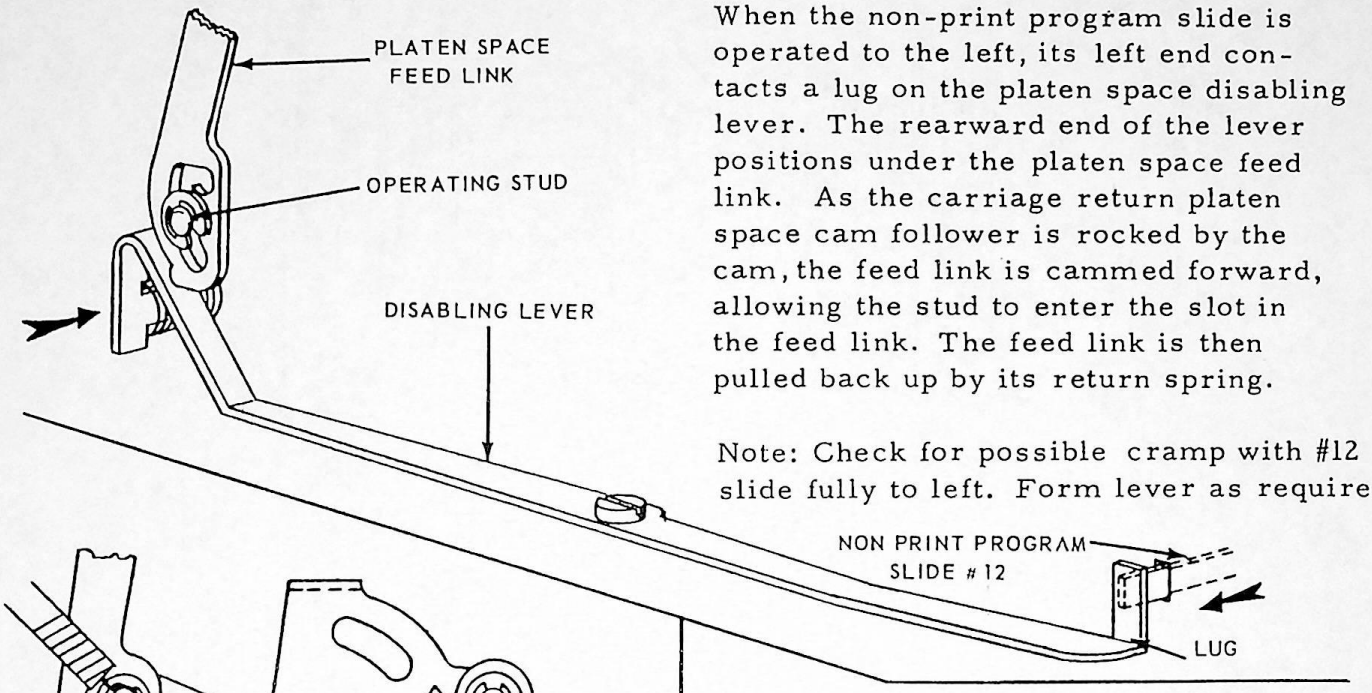
The clear program bail moves the non-print program slide (#12) to the left on the program feed stroke (first 24° of main cam shaft rotation). The program slide pivots its bell crank. . . pulling the non-print control slide forward. The lug on the rear of the non-print control slide pivots the latch positioning arm... which pivots the raising bail latch assembly... moving the raising bail latch out from under the hammer latch raising bail.





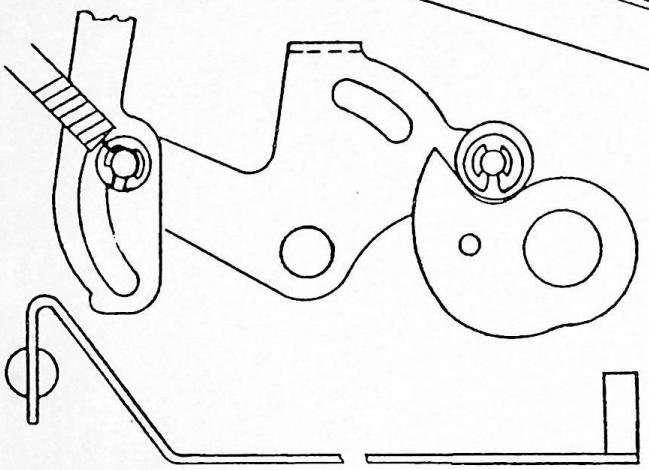
Therefore.. when the print hammer cam follower lifts the raising bail latch... the latch will not engage the hammer latch raising bail. This leaves the hammer latches engaged with the hammer tails... preventing release of the hammers and resulting in non-print. (Printing will be covered in the next section..."NON-ADD KEY".)

Platen Spacing Disabling Lever



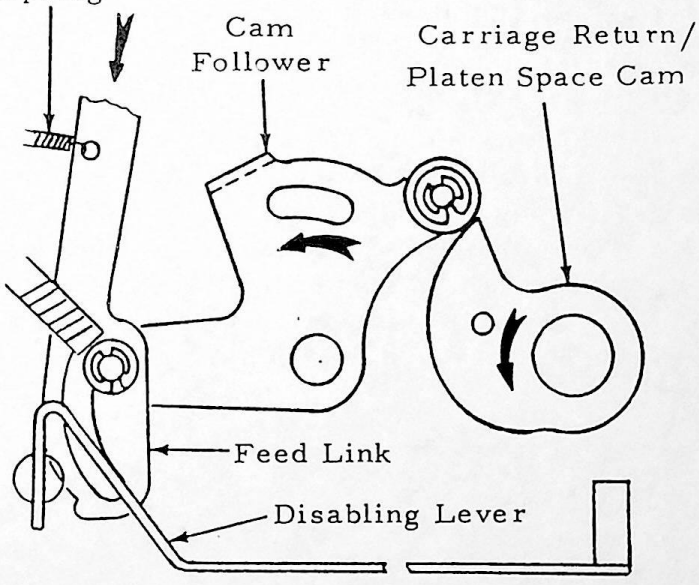
When the non-print program slide is operated to the left, its left end contacts a lug on the platen space disabling lever. The rearward end of the lever positions under the platen space feed link. As the carriage return platen space cam follower is rocked by the cam, the feed link is cammed forward, allowing the stud to enter the slot in the feed link. The feed link is then pulled back up by its return spring.

Note: Check for possible cramp with #12 slide fully to left. Form lever as required.



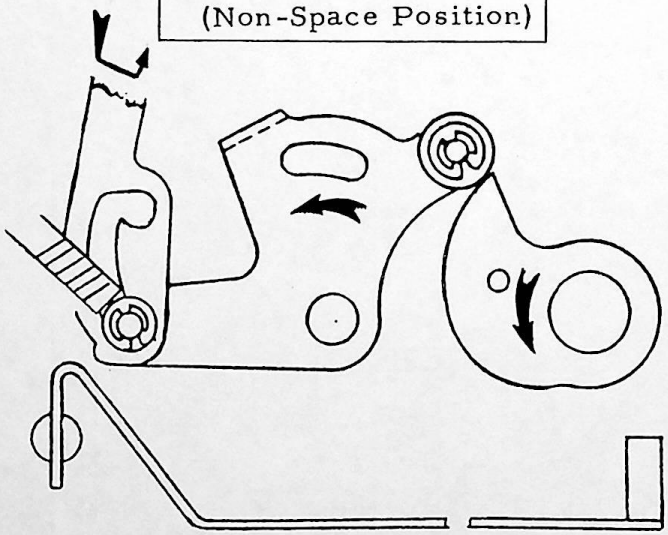
Normal Position

Disabling Lever Not Active (Platen Space Position)



The diagram above shows the feed link at the point of full movement for spacing the platen when the disabling lever is not activated.

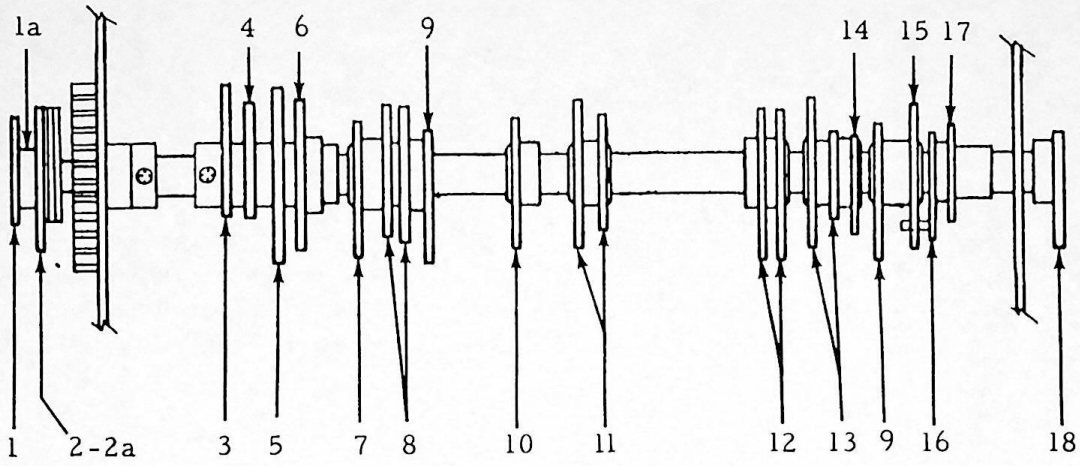
Disabling Lever Active (Non-Space Position)



The diagram at the left shows the disabled position of the feel link after contacting the activated disabling lever.

With control lever in double space position, check for disabling of feed link before engagement of feed pawl with platen ratchet gear... adjust cam angle of disabling lever as required.

MAIN CAM SHAFT

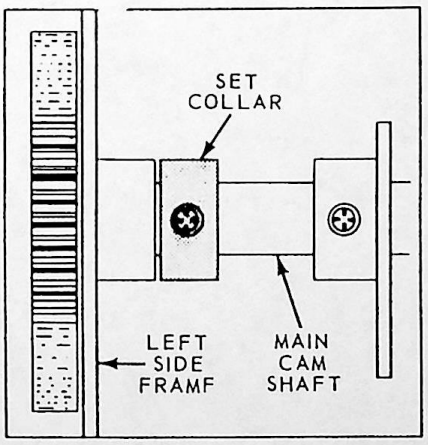


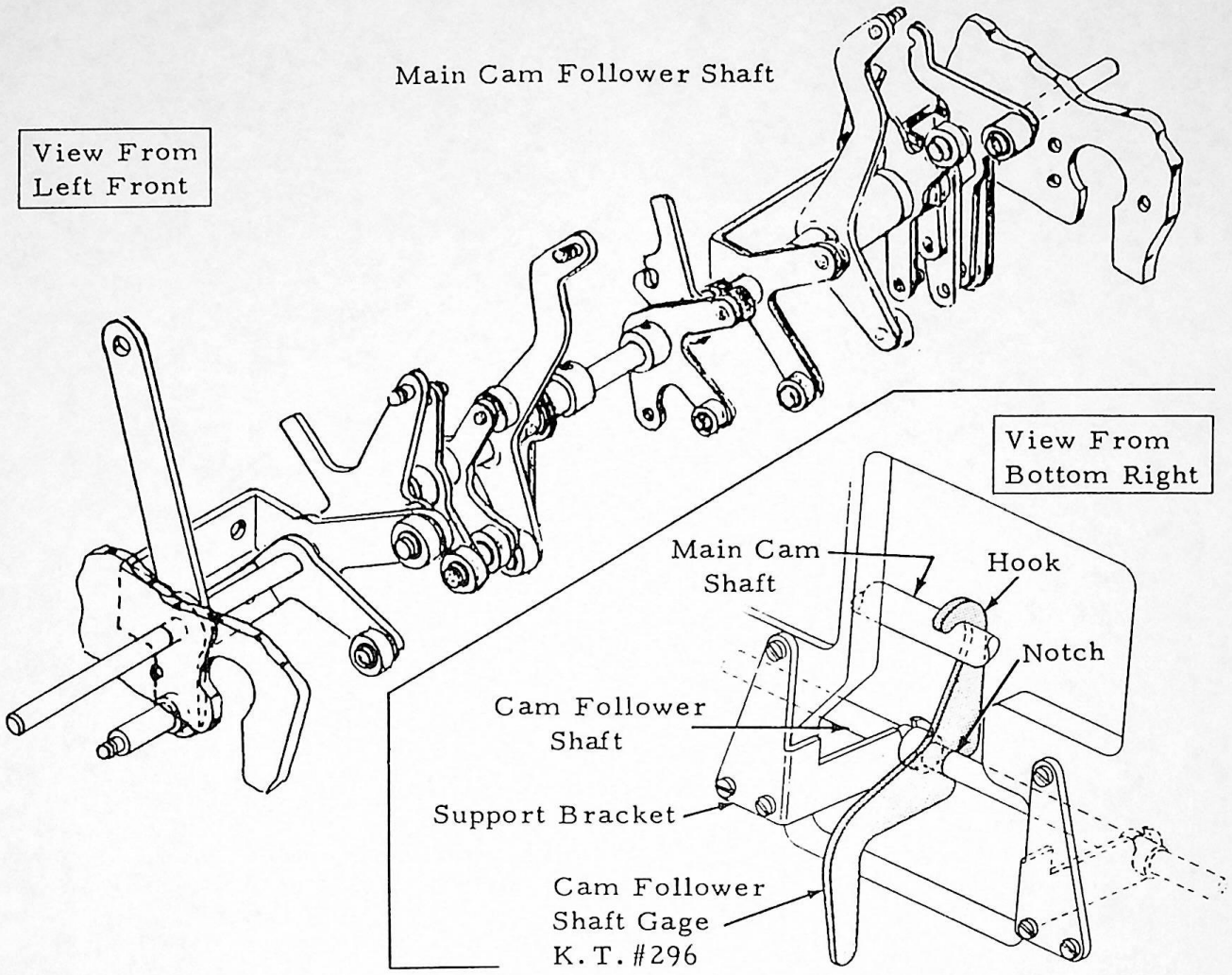
1- Carriage Return / Platen Space
1a- Decimal Shaft Location (notch in hub)
2- Hold-Up Reset
2a- Key Restoring
3- Selector Clear
4- Selector Up and Down
5- Selector Positioning
(Three Cam Cluster)
6- Selector Cluster Clutch Disc
7- Accumulator Total Hook Lock
8- Accumulator Carry
9- Racks
10- Rack Aligner
11- Program
12- Plus and Minus
13- Print Hammers
14- Decimal Print Actuator
15- Accumulator Position (+ and -)
16- Sub-Total
17- Total
18- Detent-Equalizer

The main cam shaft has twenty four cams that operate cam followers which move links, latches, and arms up, down, left and right, at the proper time during the 360° cycle of the main cam shaft. The three cam cluster located just inside the left hand side frame is not pinned to the shaft. It rotates with the shaft only when another clutch is tripped with the main clutch. The two cams to the inside of the right hand side frame slide left and right on the shaft, and are driven by a pin extending through a hole in the cam to the left.

Adjustment

Check end play of main cam shaft. Shaft should have minimum end play without binds. Adjust if required, by positioning the set collar located inside left side frame.





Main Cam Follower Shaft

The rotary motion of the cams on the main cam shaft is translated into various reciprocating movements through a series of cam followers. Most of the cam followers are assembled to a fixed shaft called the cam follower shaft.

The cam follower shaft must be held firmly so that its parallel relationship to the main cam shaft does not vary with fluctuations in load on the cam followers. Two brackets have been provided to support the cam follower shaft. The mounting holes in the support brackets are slightly oversize. The oversize holes permit a slight adjustment in the relationship between the two shafts.

Adjustment

1. The alignment between the main cam shaft and the cam follower shaft is checked with a gage (K.T. #296). The alignment should be checked in an area adjacent to each support bracket. To check the alignment, slip the "hook" end of the gage over the main cam shaft. Hold gage firmly against cam shaft. The notch of the gage should then fit freely over the cam follower shaft. If adjustment is required, back off on support bracket screws just enough to permit the brackets to be moved with a hammer and brass. Tap forward or rearward as required to obtain free fit of gage.
2. Check lateral zoning of cam follower rollers to cams.

Dalon 10-18-67

IC-1421 TEST #1

1. What mechanisms will be operated by direct contact of the clear key when it is depressed?

2. What program slides will be operated by the clear program bail?

3. Explain the function of each program slide operated by the clear program bail during the first 24° of the cycle.

4. Explain the function of the 52 operating slide on a clear key function.

5. What are the two functions of the rack aligners?

6. At what time in a machine cycle will the rack aligners be active?

7. On what part of a machine cycle do we enter into the various sets of gears?

8. What part of a machine cycle do we use for programing?

9. On what part of a machine cycle do we total the various gears?

10. From what two sources can the switch be closed?

11. Explain the function of the non-repeat bail when it is activated.

12. What mechanism will prevent a repeat cycle when a function key is held depressed?

13. Meshing the set-up carriage with the racks will disengage what mechanism?

14. What prevents the racks to the left and right of the set-up gears from going to the rear when the set-up carriage is in mesh with the racks?

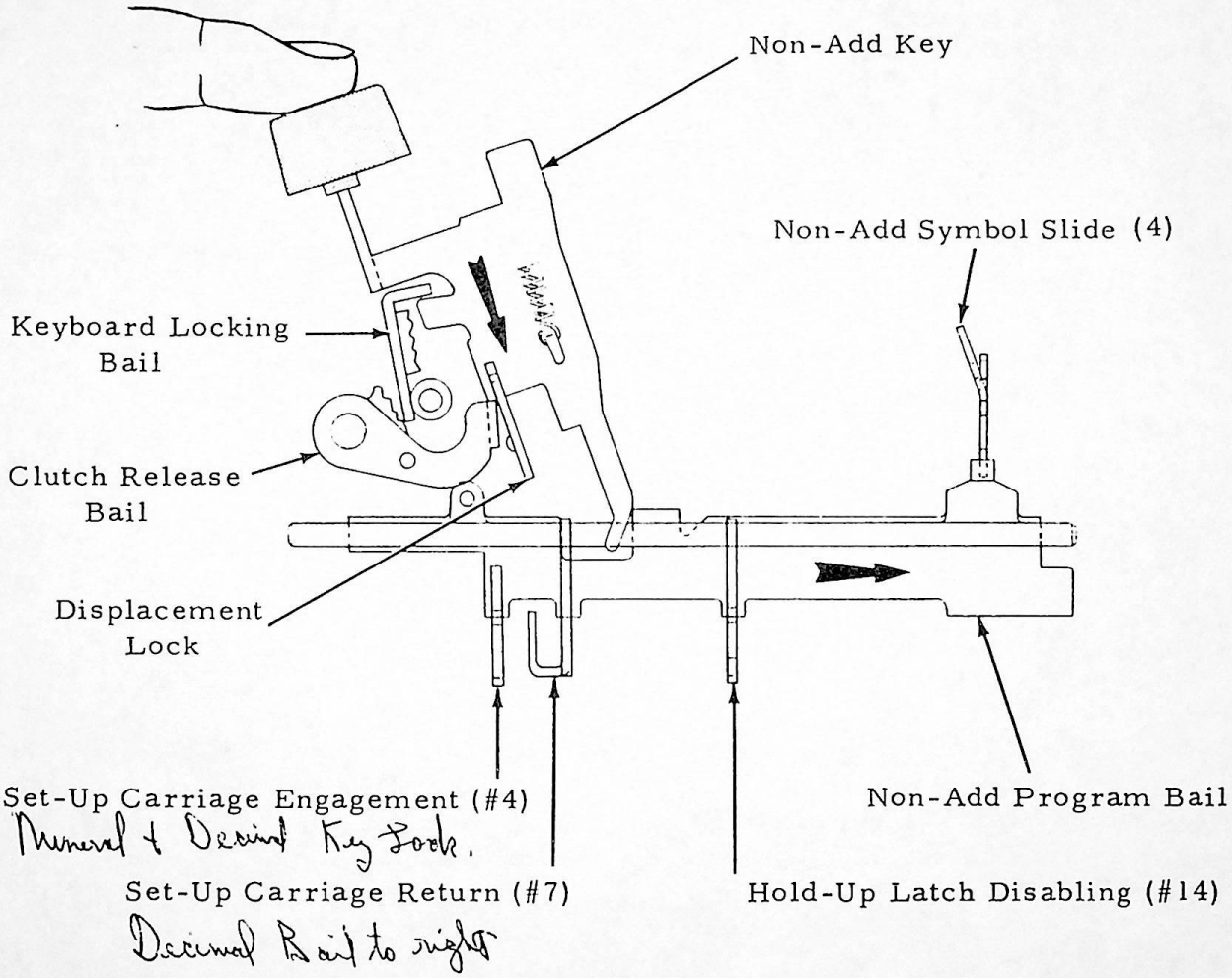
15. Name all the sets of gears that can be meshed with the rear racks.

16. Explain the function of the supplemental lock and what keys will activate it.

17. The pivoting of the cable drum during a set-up carriage return operates what mechanism?

18. On an entry into the set-up carriage what mechanism determines the number of teeth the set-up gear will be displaced?

19. The set-up clutch when rotated operates what mechanisms?


Non-Add Key
Non-Add Symbol Slide (4)
Keyboard Locking Bail
Clutch Release Bail
Displacement Lock
Set-Up Carriage Engagement (#4)
Numeral & Decimal Key Lock.
Set-Up Carriage Return (#7)
Decimal Rail to right
Hold-Up Latch Disabling (#14)
Non-Add Program Bail

Depression of the Non-Add key operates the keyboard locking bail and clutch release bail...and engages the displacement lock. The keystem action is the same as the clear key, except...the non-add program bail is pushed into engagement with the program feed plate instead of the clear program bail.
bail.

The non-add program bail is very similar to the clear program bail....When rocked by the feed plate both bails operate the set-up carriage engagement program slide (#4), the set-up carriage return program slide (#7), and the hold-up latch disabling program slide (#14).

There are two differences however in the action of these program bails. First...the non-add bail does not activate the non-print slide as did the clear bail. Thus, any numeral entry contained by the set-up carriage will be printed. Secondly...the non-add bail contains a symbol lug which operates the non-add symbol slide to the right.

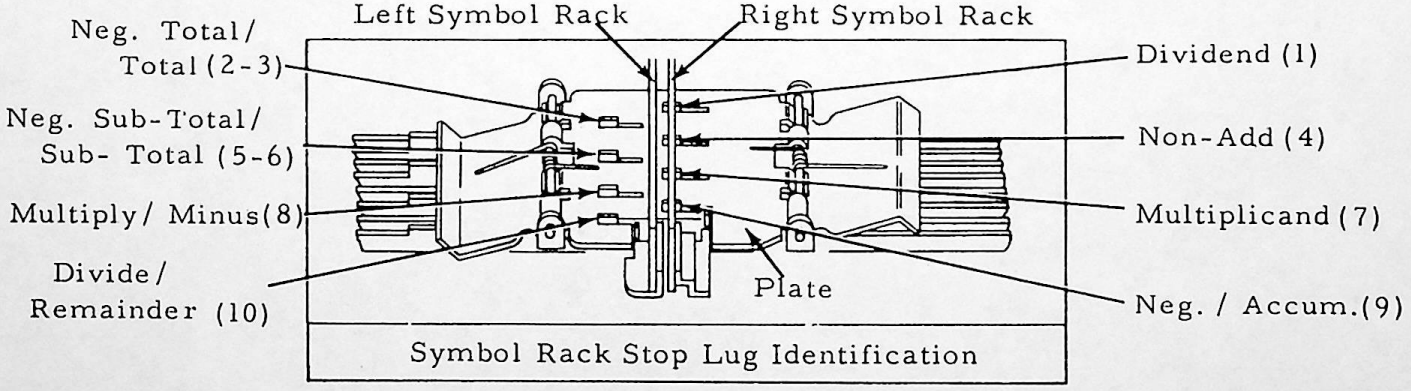
Symbol Slides and Racks

There are eight symbol slides that are operated to the right by the program bails or cams.

They are shown on page IV-B-4 where they are identified by the circled numerals 1, 3, 4, 6, 7, 8, 9 and 10. Of these...slides 3 and 6 do not contain the upward projecting "symbol rack stop lug". The symbol rack stop lugs for slides 3 and 6 are on a separate pair of slides identified by the circled numerals 2 and 5. Slides 2 and 3 are connected by a spring and, from a functional standpoint, should be considered as a single (but flexible) symbol slide. The same is true of slides 5 and 6....Therefore, although there are ten sliding members in the symbol program unit, they should be regarded as eight symbol slides...two flexible...and six rigid.

NOTE: The two flexible symbol slides will be described in detail under "TOTAL KEY".

The symbol slides have symbol rack stop lugs extending upward. These lugs protrude thru a plate at the top right side of the symbol unit. When activated, these lugs stop the rearward travel of the symbol printing racks. The positions in which the racks are stopped determines the symbols that will be printed.



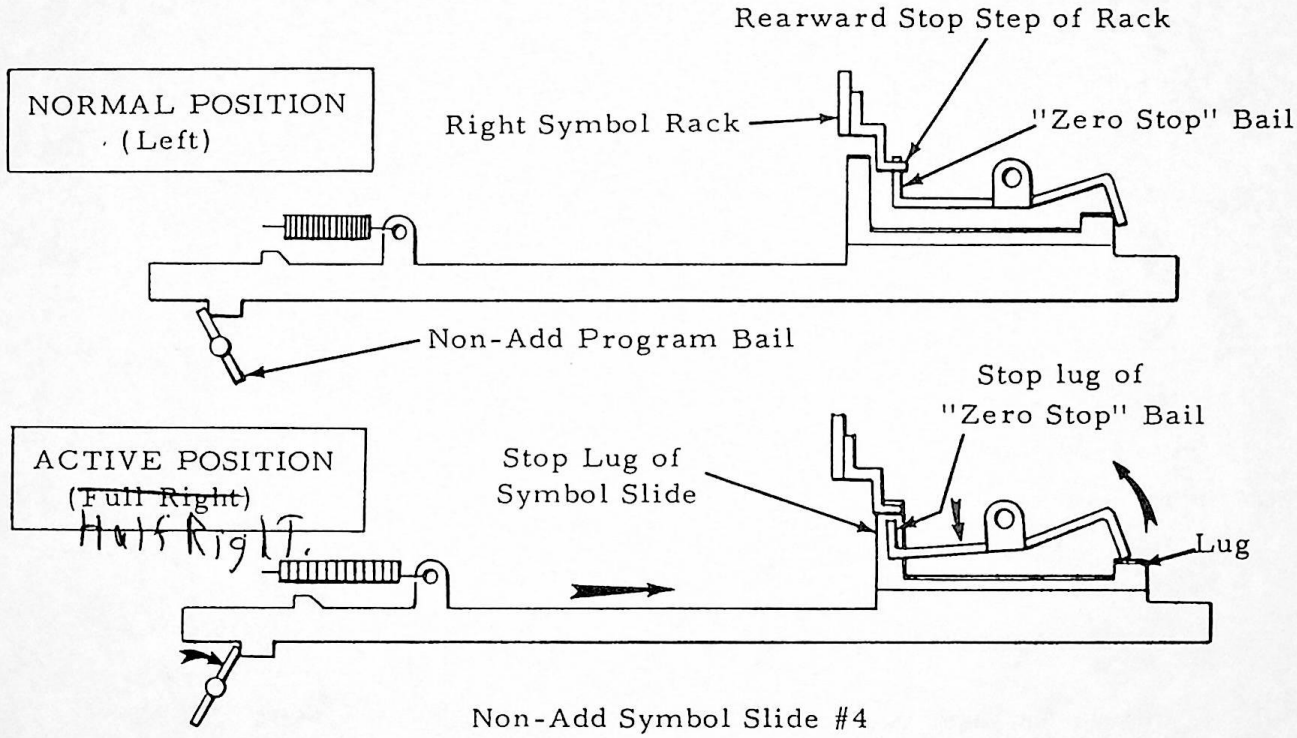
Symbol Rack Stop Lug Identification

Four of the symbol slides (Nos. 2-3, 5-6, 8 and 10) operate in conjunction with the left symbol rack and the other four (Nos. 1, 4, 7 and 9) work with the right symbol rack.

The non-add symbol slide (#4) therefore is used to stop the right symbol rack on non-add functions at the point where the rack has turned the non-add symbol on the print wheel into alignment with the platen.

There are two "zero stop" bails in the symbol unit. . . one for each symbol rack. They are used to keep the symbol racks in restored position. With the symbol racks in restored position, their respective print hammers will not be "fired" on a printing operation.

Whenever a symbol slide is activated, a lug on the top edge of the symbol slide contacts the related "zero stop" bail and pivots the bail. . . moving the zero stop lug of the bail out of the path of the symbol rack. This permits the rack to move rearward.



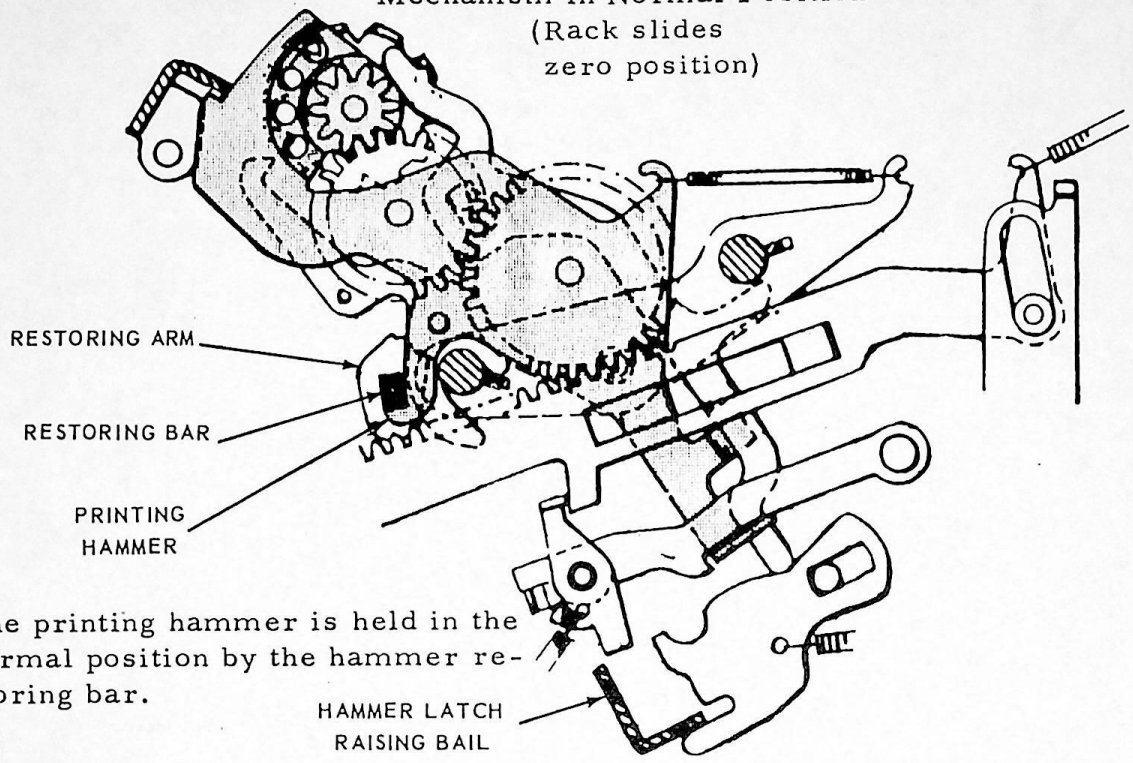
Non-Add Symbol Slide #4

Five of the symbol slides (Nos. 2-3, 5-6, 8, 9 and 10) are three position slides.... That is, they have a neutral position (left) and two active positions (half right and full right).

The other three symbol slides (Nos. 1, 4 and 7) are two position slides.... They have a neutral position (left) and one active position either half or full right.

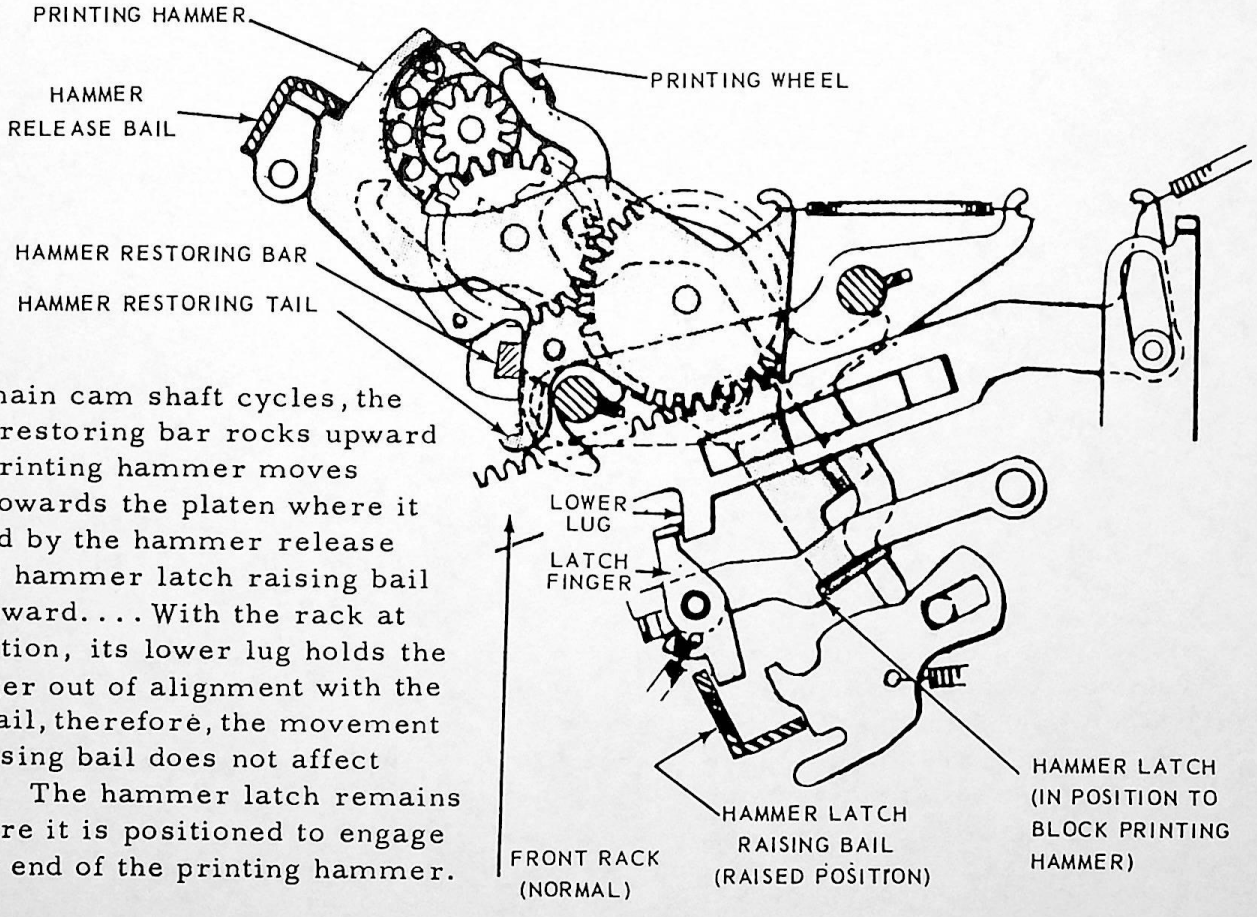
Both symbol racks have stop extensions for engaging the stop lugs of the symbol slides. The stop extensions each have two "stop steps"; a forward step and a rearward step. The forward step engages the stop lug when a symbol slide is in its half right position and the rearward step engages when the slide is in the full right position. A three position symbol slide, therefore, can stop its symbol rack in either of two positions for printing either of two symbols. The two position symbol slides engage only the rearward stop step of the symbol rack and therefore control the printing of just one symbol.

- Printing -
Mechanism in Normal Position
(Rack slides
zero position)



The printing hammer is held in the normal position by the hammer restoring bar.

Printing Hammer Held By The Hammer Release Bail
(Rack slides zero position)

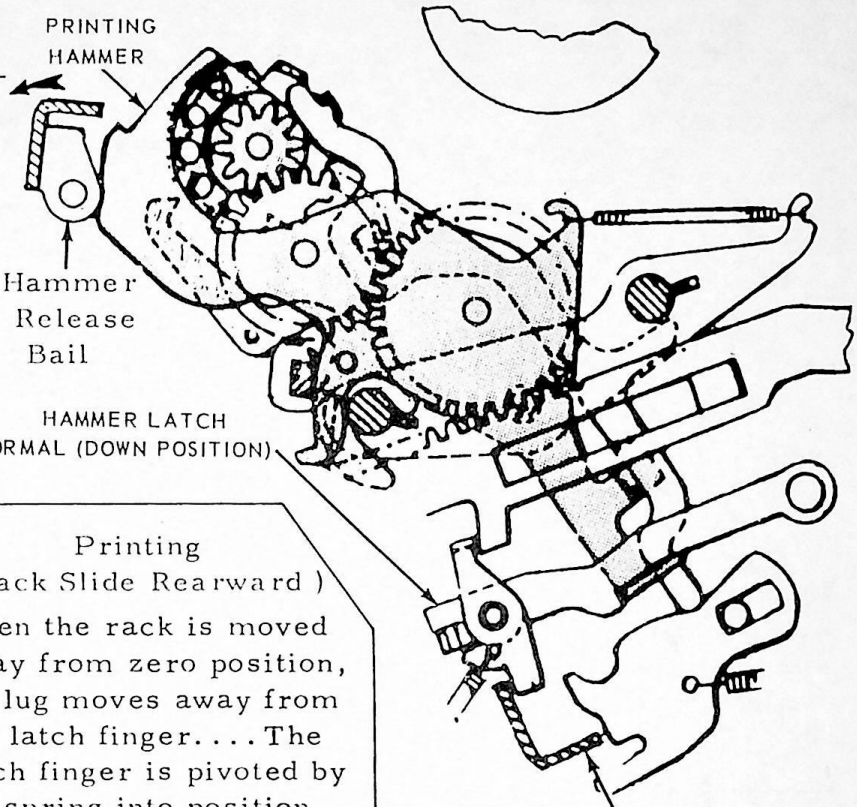


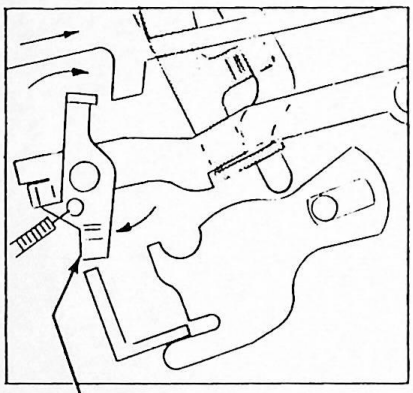
As the main cam shaft cycles, the hammer restoring bar rocks upward and the printing hammer moves slightly towards the platen where it is stopped by the hammer release bail. The hammer latch raising bail moves upward.... With the rack at zero position, its lower lug holds the latch finger out of alignment with the raising bail, therefore, the movement of the raising bail does not affect the latch. The hammer latch remains down where it is positioned to engage the lower end of the printing hammer.

Printing Hammer Blocked by Hammer Latch (Racks in Zero Position)

Further cycling raises the hammer release bail. The hammer again starts to move toward the platen but is immediately engaged by the hammer latch and no print occurs.

As the cycle is completed, all the subject mechanism is restored to normal.



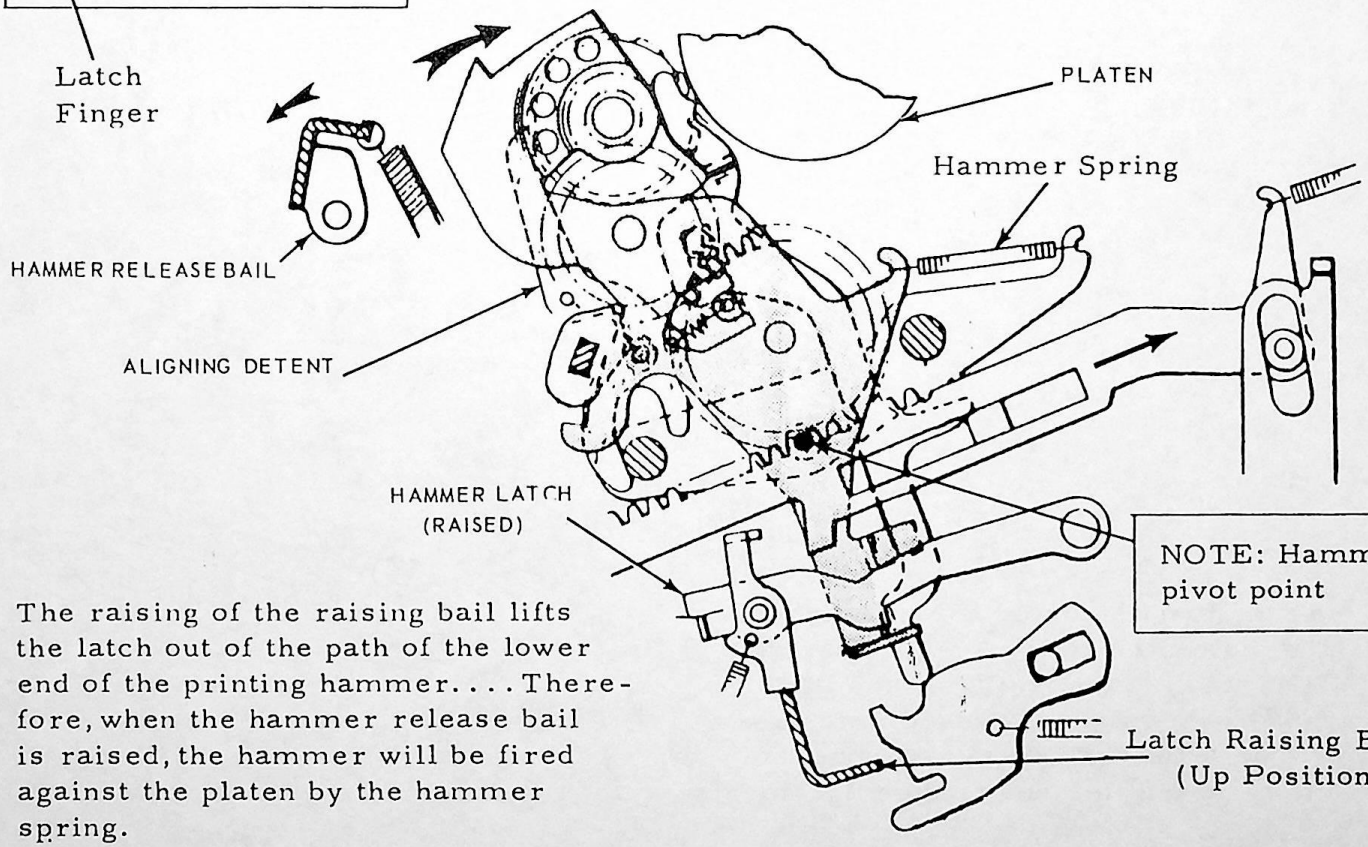


Latch Finger

Printing (Rack Slide Rearward)

When the rack is moved away from zero position, its lug moves away from the latch finger. . . . The latch finger is pivoted by its spring into position above the latch raising bail.

Latch Raising Bail (Up Position)

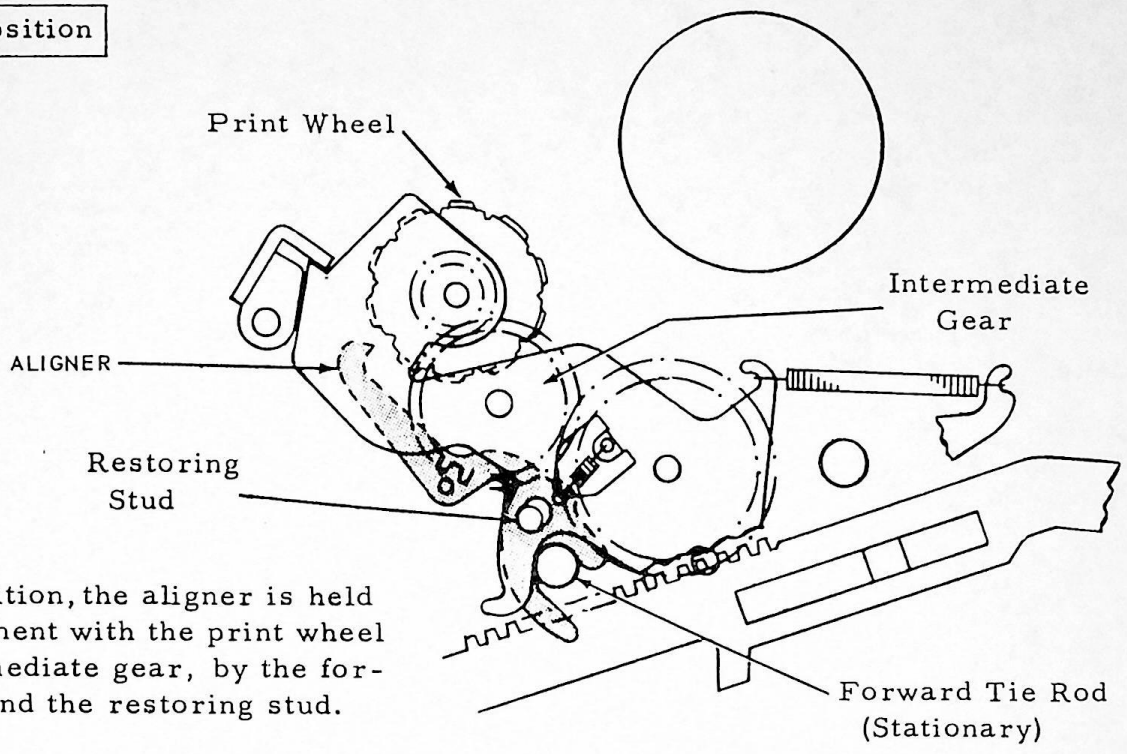


NOTE: Hammer pivot point

The raising of the raising bail lifts the latch out of the path of the lower end of the printing hammer. . . . Therefore, when the hammer release bail is raised, the hammer will be fired against the platen by the hammer spring.

Print Wheel Aligner

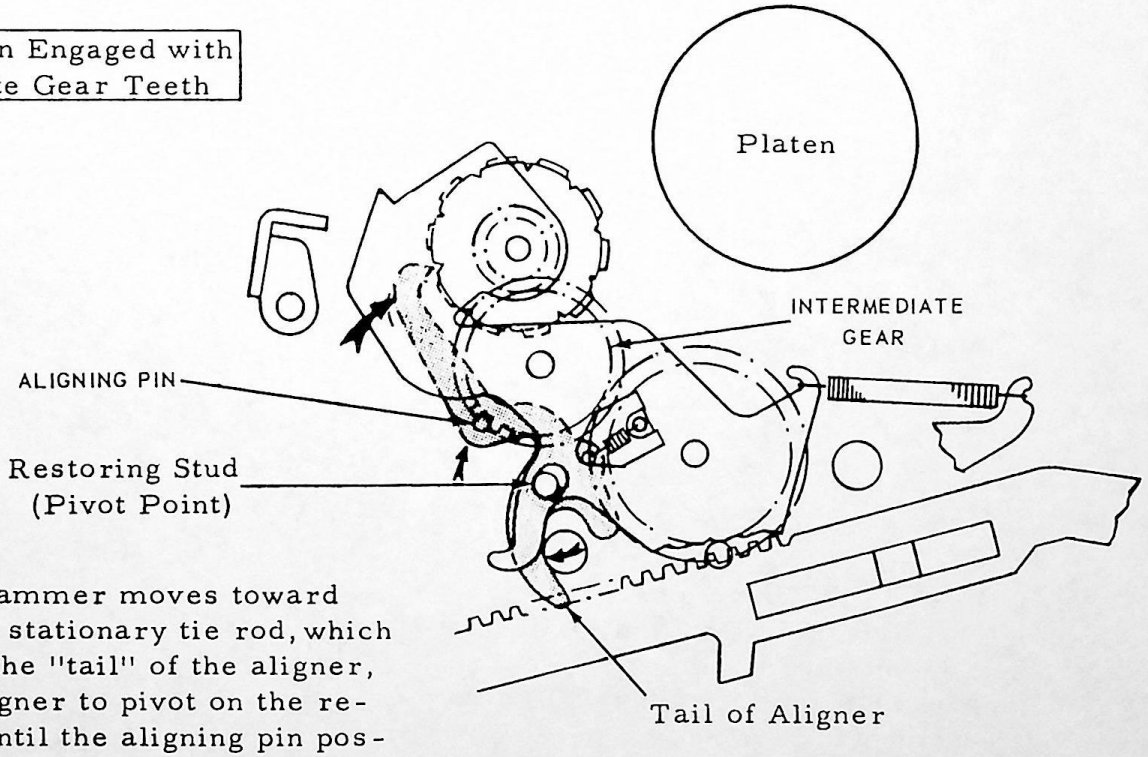
Normal Position



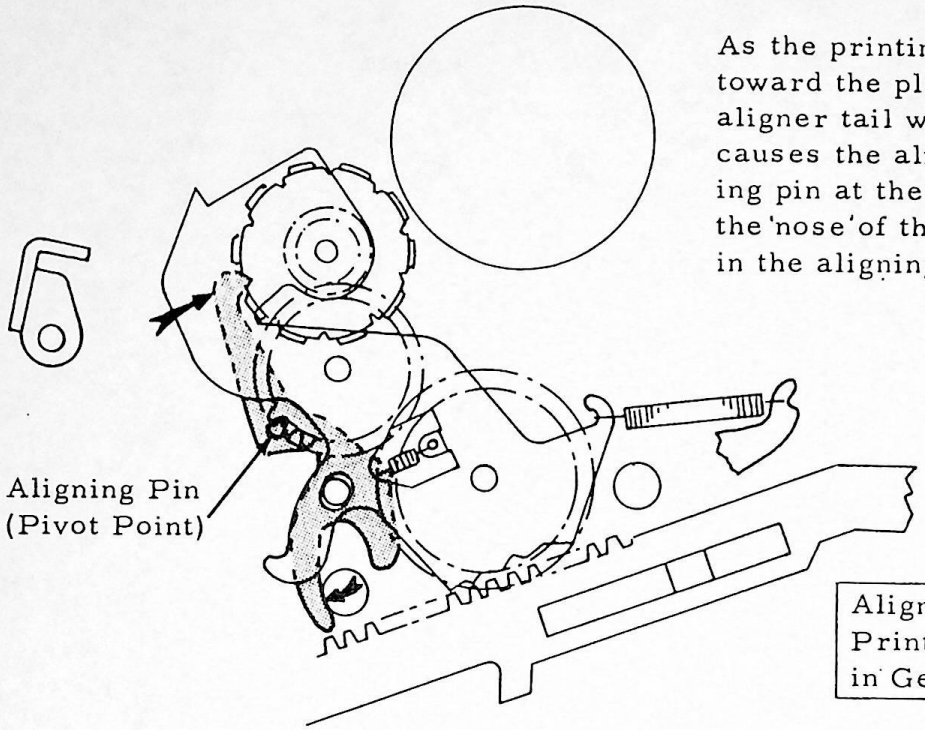
In neutral position, the aligner is held out of engagement with the print wheel and the intermediate gear, by the forward tie rod and the restoring stud.

Partial Aligning

Aligning Pin Engaged with Intermediate Gear Teeth



As the print hammer moves toward the platen, the stationary tie rod, which is contacting the "tail" of the aligner, causes the aligner to pivot on the restoring stud until the aligning pin positions to the full depth of the intermediate gear tooth.

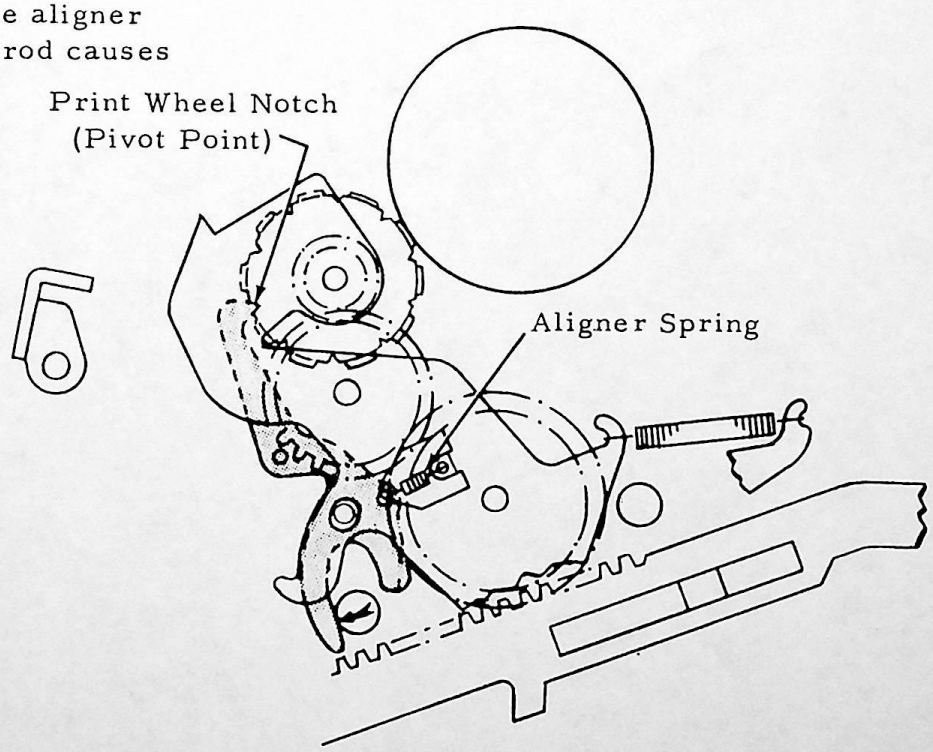


As the printing hammer moves further toward the platen, the contact of the aligner tail with the stationary tie rod causes the aligner to pivot on the aligning pin at the intermediate gear until the 'nose' of the aligner positions fully in the aligning notch of the print wheel.

Aligner 'Nose' Engaged with Print Wheel Notch... Pin still in Gear Teeth.

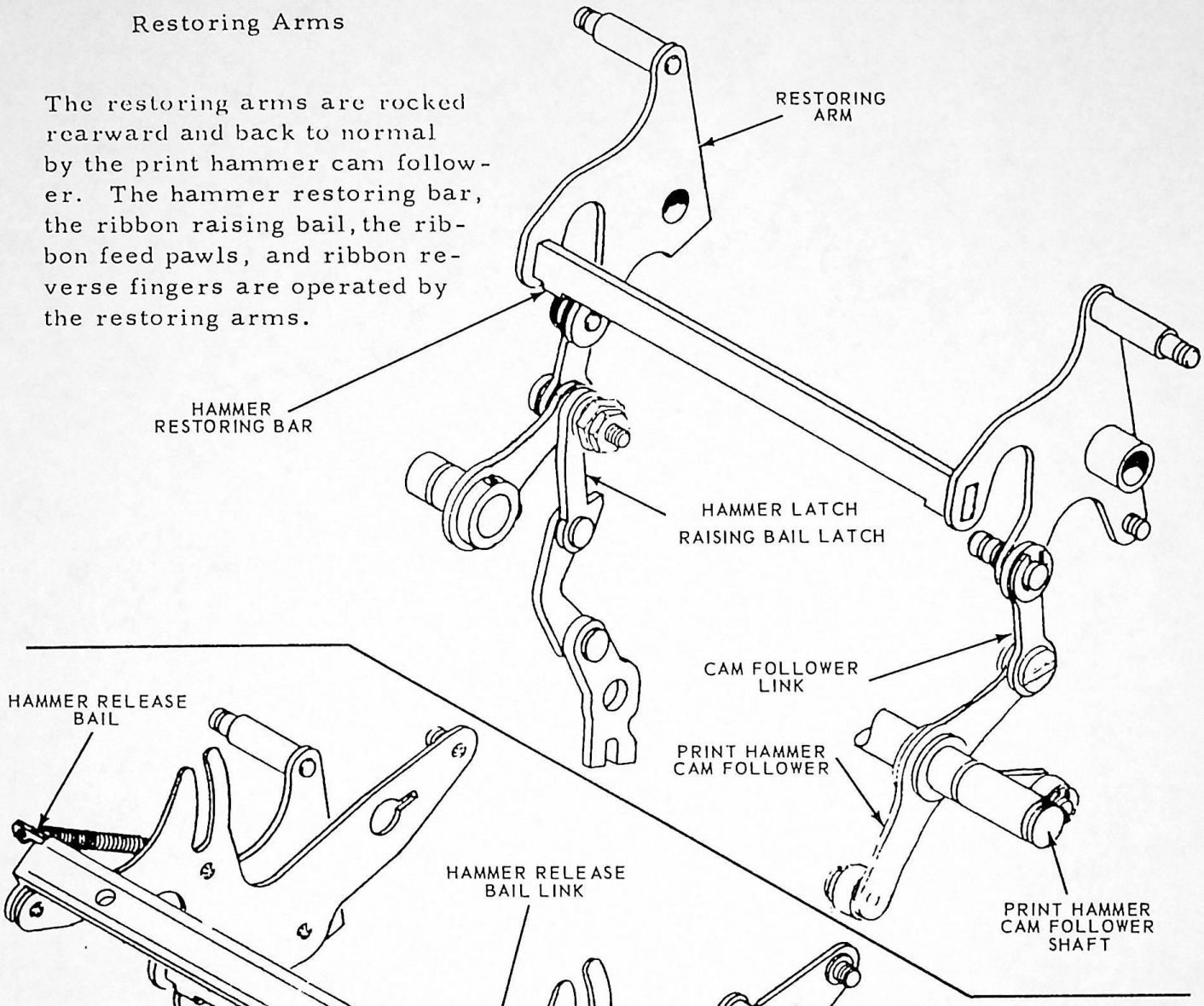
Aligner 'Nose' in Print Wheel Notch under Spring Tension... Pin out of Engagement with Gear Teeth

Just before the print wheel strikes the platen, the contact of the aligner tail with the stationary tie rod causes the aligner to pivot very slightly at the notch of the print wheel. This causes the aligning pin to move outward from the intermediate gear and holds the aligner firmly in the print wheel notch under the tension of the aligner spring as the figure is printed.



Restoring Arms

The restoring arms are rocked rearward and back to normal by the print hammer cam follower. The hammer restoring bar, the ribbon raising bail, the ribbon feed pawls, and ribbon reverse fingers are operated by the restoring arms.

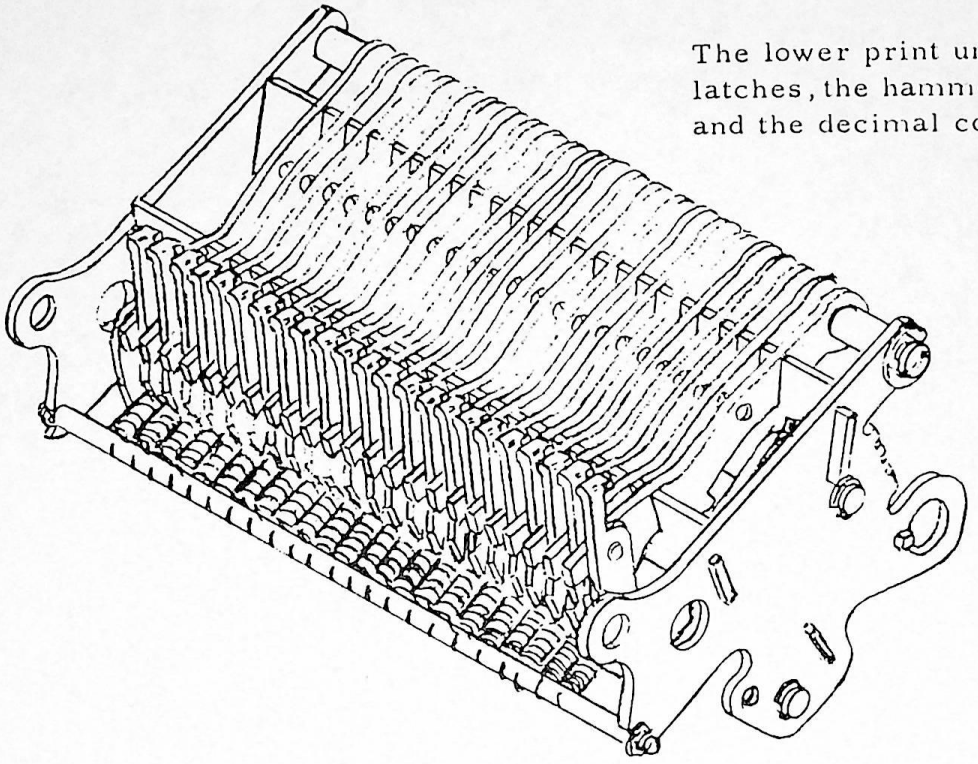


Print Hammer Cam Follower

The print hammer cam follower also operates the latch for the hammer latch raising bail and the hammer release bail link.

NOTE: The print hammer cam follower is one of the four double cam operated cam followers.

Lower Print Unit



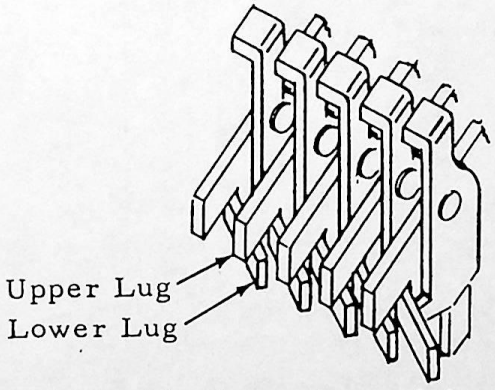
The lower print unit contains the hammer latches, the hammer latch raising bail and the decimal control fingers.

Hammer Latches

It was shown previously that with a rack at zero position... the hammer latch finger cannot position over the hammer latch raising bail. Therefore, when the bail is raised the latch is not ... and it prevents the hammer from printing the zero.

Whenever we have a significant digit to be printed to the left of a zero or group of zeros, however, it is necessary that the zeros be printed. Therefore, the hammer latches in the "zero columns" must be raised by the raising of the latch in the column containing the numeral.

Overlapping of Hammer Latches



The forward ends of the hammer latches are lanced to provide two lugs.... The lower lug is formed to the right so that it positions under the straight upper lug of the latch to the right. The upper lug, therefore, of each numeral column latch overlaps the lower lug of the next latch to its left.

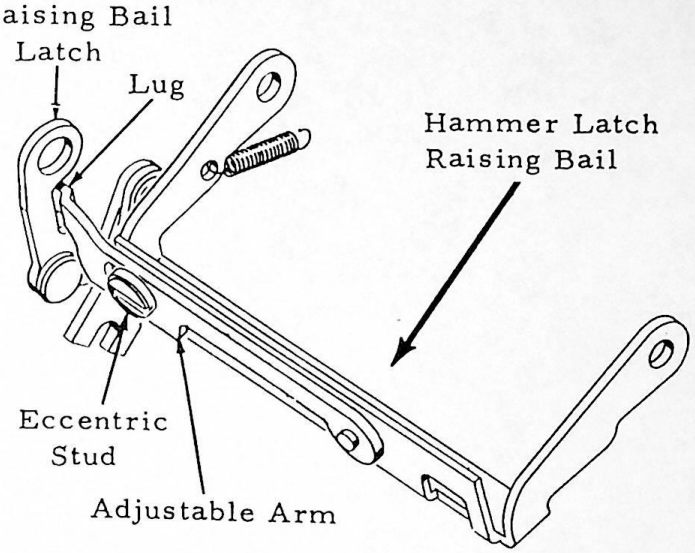
Therefore, when a latch to the left of a "zero latch" is raised, its lower lug lifts the next latch to the right.

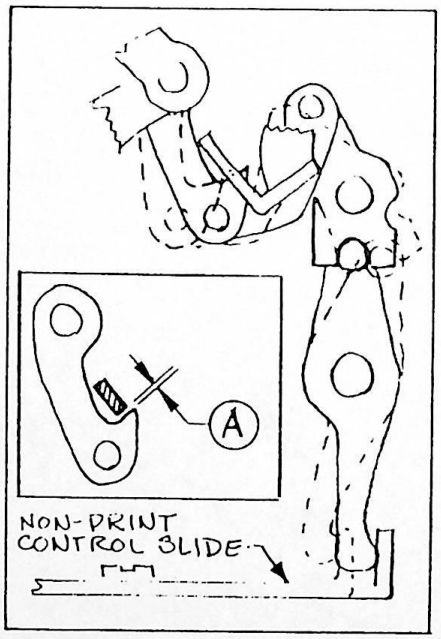
NOTE: The lower lugs of the hammer latches for the two symbol columns and the first numeral column are clipped.. to disable the "zero release" action in the symbol columns.

Hammer Latch Raising Bail

In normal position, a spring holds the hammer latch raising bail down on top of the lower extensions of the decimal control fingers. The decimal control fingers are also held down, and to the rear, by individual springs. The lower extensions of the decimal control fingers rest on top of the lower tie rod of the lower print unit. The raising bail latch assembly and its normalizing spring are mounted at the left end of the lower tie rod.

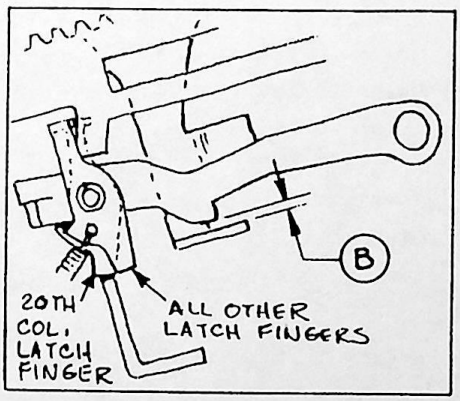
An adjustable arm mounted on the forward upright forming of the raising bail contains the lug that is engaged by the raising bail latch to lift the raising bail. An eccentric shoulder stud holds the left end of the arm in position. The stud is riveted with a friction washer and it contains a screwdriver slot so that it can be turned to adjust the position of the arm. The adjustment provides a means of controlling the relationship between the lug of the raising bail arm and the raising bail latch.





Adjustment

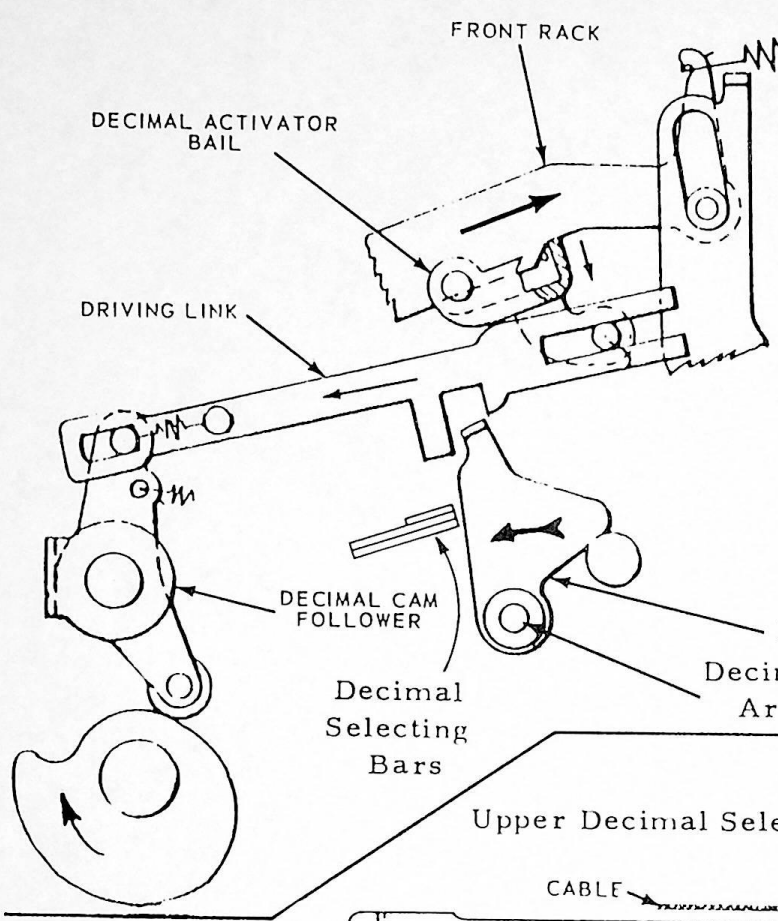
The raising bail latch should have enough clearance (A) at the lug of the raising bail to move freely into and out of engaging position when the non-print control slide is operated.



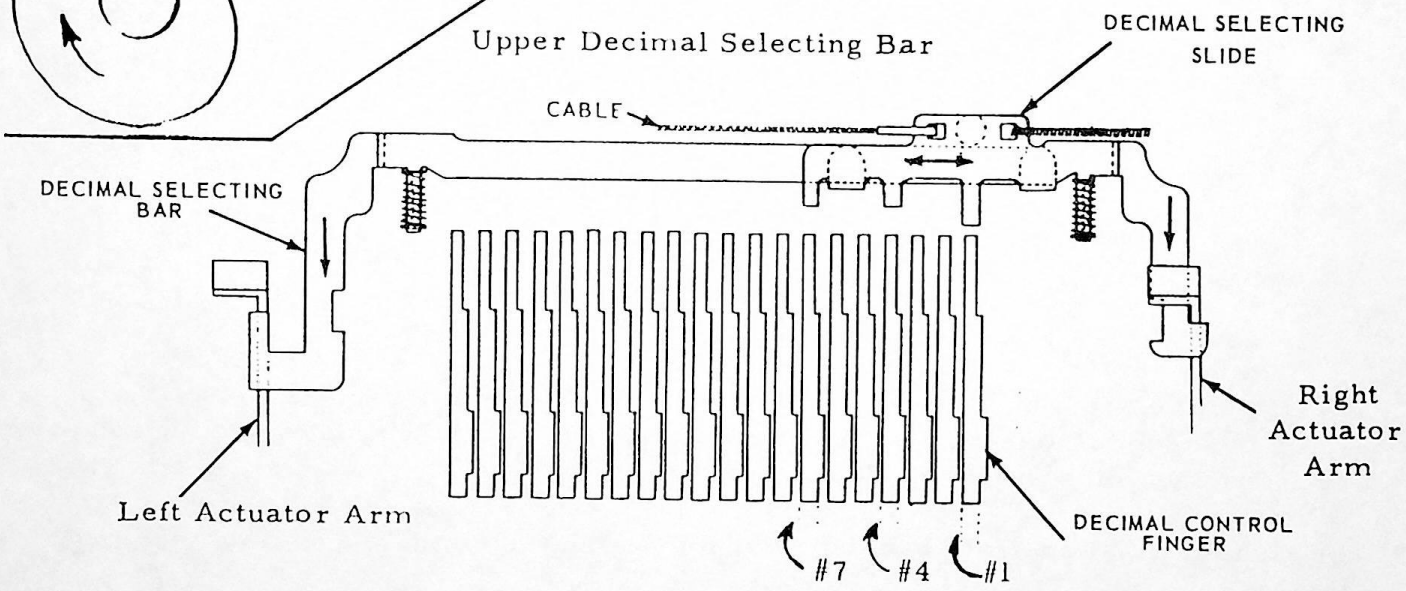
The raising bail should be raised high enough to provide hammer release clearance (B) under all overlapping hammer latches to the right of a single significant digit in the 20th numeral column on a hand operated plus cycle.

Adjust slotted eccentric stud as required.

Positioning The Decimal Control Finger



The front rack, in its rearward movement, depresses the decimal activator bail which engages the driving link of the decimal cam follower with the right actuator arm of the decimal actuator arm shaft. The rocking of the decimal actuator arms forward, actuates one of the three decimal selecting bars. The decimal selecting bar couples the decimal control finger to the hammer latch raising bail. NOTE: On a non-add operation the upper decimal selecting bar is actuated.

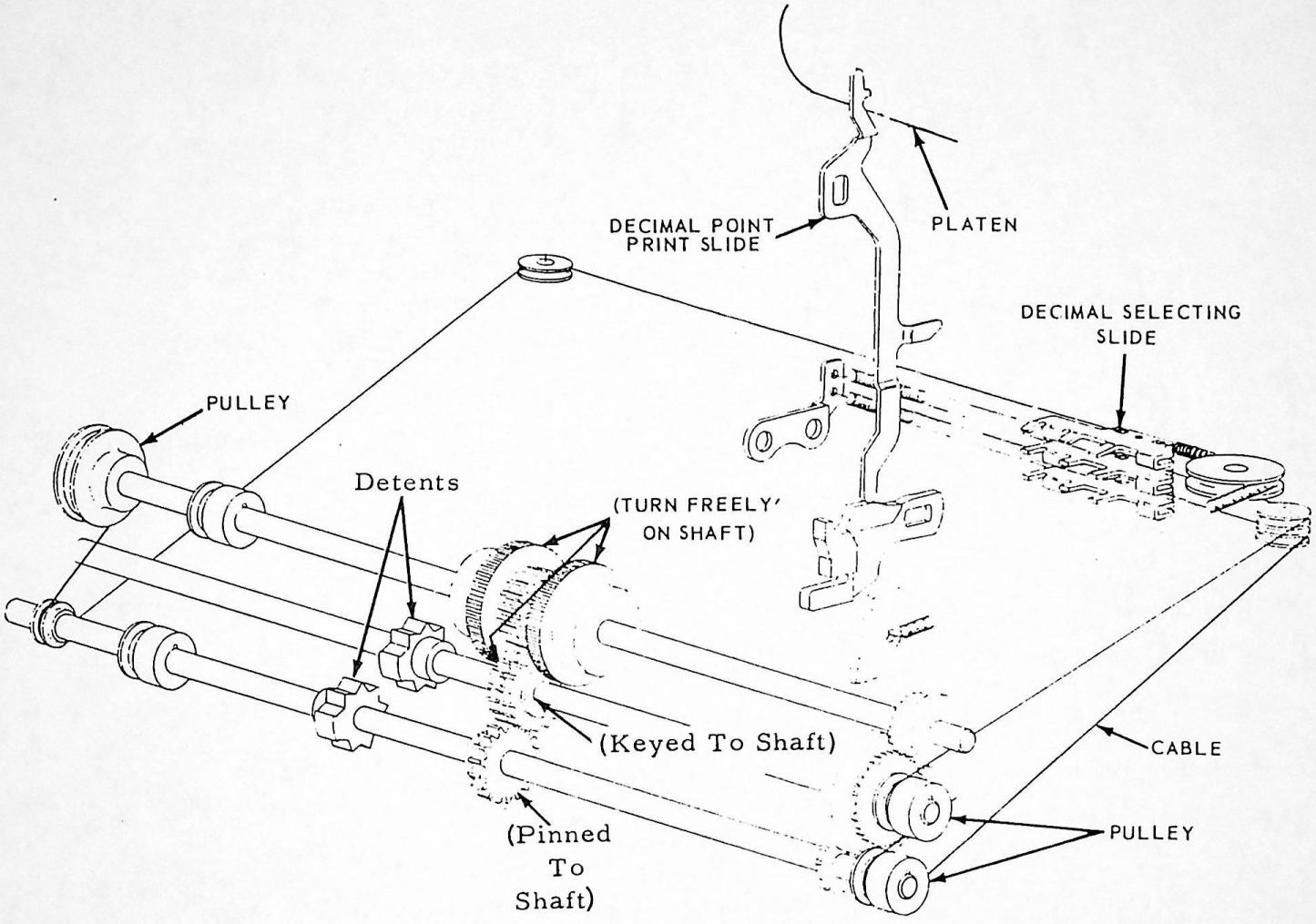


The decimal selecting bar is operated forward by the actuator arms of the decimal actuator arm shaft. The position shown above, of the decimal selecting slide, is to the right, with the long prong in position to engage the #1 decimal control finger. The long prong positions the decimal control finger to its full forward position. The short prongs are zoned to engage the #4 and #7 decimal control fingers and position the decimal control fingers to their half forward position.

NOTE: The decimal selecting slide moves left and right on the decimal selecting bar.

The position of the decimal selecting slide in the above sketch is for the pointing of a whole number (Example: 1.234.567.).

Decimal Selecting Finger



The decimal control knobs operate cables which position the decimal selecting fingers on the decimal selecting bars so that the prongs of the decimal selecting fingers are aligned with the proper decimal control fingers.

The right decimal control knob moves the upper and the middle decimal selecting slides.

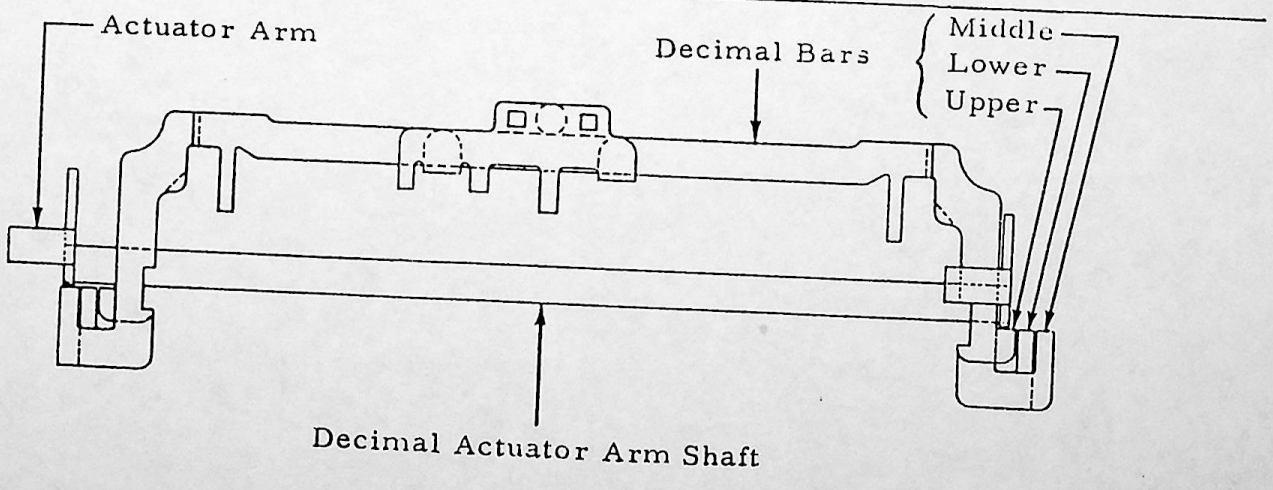
The left decimal control knob moves the upper and the lower decimal selecting slides.

Since the upper decimal selecting slide is moved by both knobs...it points off the combined setting of the two knobs....For example: With the left knob set at '2' and the right knob set at '4',the long prong of the upper slide will be aligned behind the 7th (from the right) decimal control finger. With this setting: six decimal places would be pointed off on a function using the upper slide; four places on a function using the middle slide; and two places on a function using the lower slide.

DECIMAL BAR SELECTION FROM VARIOUS FUNCTIONS

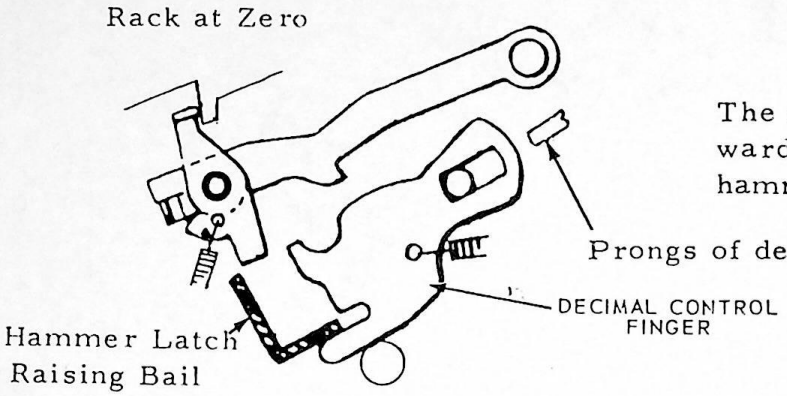
Function	Decimal Bar	Decimal Actuating Arm Position	Control of Dec. Knobs
Multiplicand (Selector)	Middle	Full Right	Right Knob
Multiplier (M/Q Gears)	Lower	Half Right	Left Knob
Product Total (Register)	Upper	Left (Normal)	Both Knobs
Enter Dividend (Register)	Upper	Left (Normal)	Both Knobs
Divisor (Selector)	Middle	Full Right	Right Knob
Quotient Total* (M/Q Gears)	Lower	Half Right	Left Knob
Remainder (Register)	Upper	Left (Normal)	Both Knobs
Plus Minus Sub Total Total (Accumulator)	Upper	Left (Normal)	Both Knobs
Transfer Multiplicand (Accumulator to Selector)	Upper	Left (Normal)	Both Knobs

*NOTE: On Quotient Transfers, both decimal knobs must be at same setting for proper decimal alignment of amount transferred to selector.



Decimal Selecting Finger

Decimal Control Finger Normal Position
(Not engaged with selecting slide)

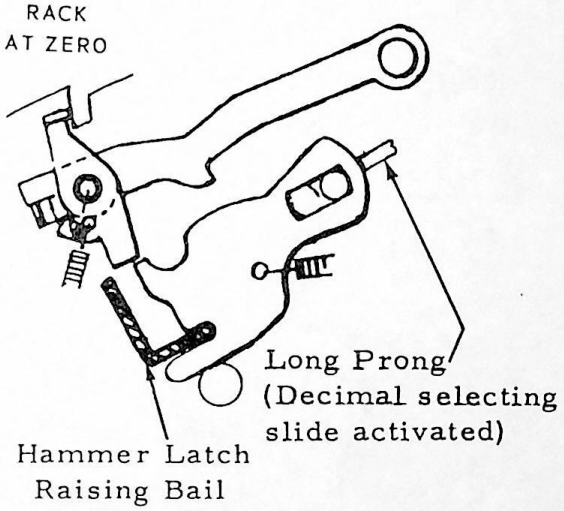


The decimal control finger in its rearward position is not coupled with the hammer latch raising bail.

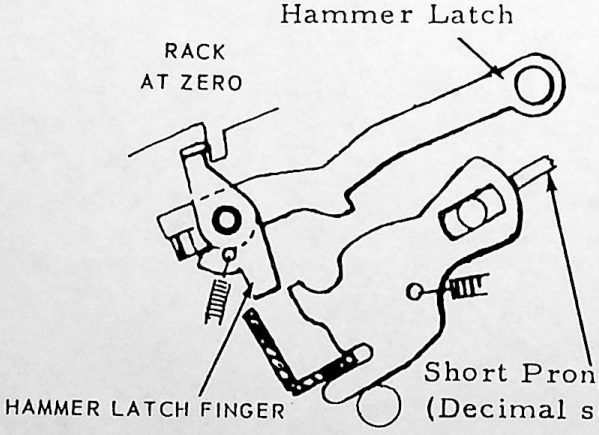
Decimal Control Finger Full Forward Position
(Engaged by long prong of selecting slide)

The decimal control finger in the full forward position, couples with the hammer raising bail and is under the hammer latch. In this position the hammer will be released even though the rack is at zero and there is not a significant digit to the left.
This is the means by which a whole number 'zero' with a decimal point and any intervening zeros are printed to the left of a significant digit.

NOTE: If there were no significant digit at all, the decimal activator bail (Page IV-D-10) would not have activated the mechanism to position the decimal control fingers. The fingers would remain rearward (top picture) and no print would occur... regardless of the decimal setting.



Decimal Control Finger Half Forward Position
(Engaged by short prong of selecting slide)



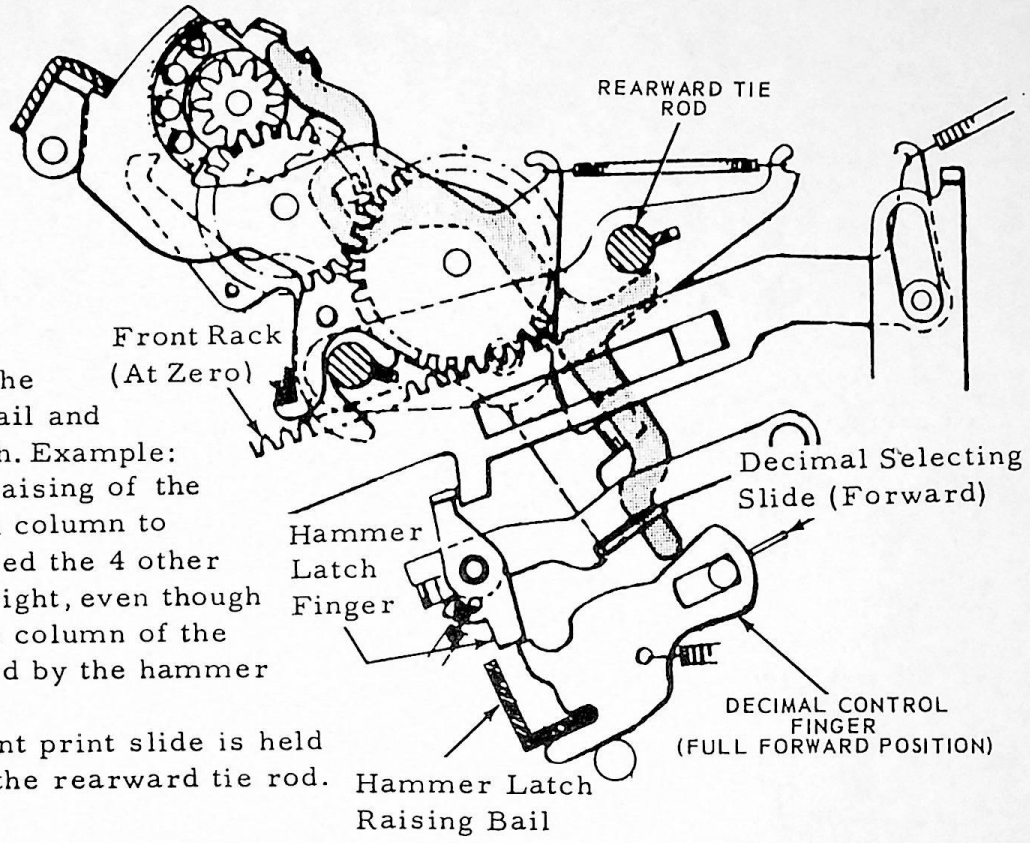
The decimal control finger in the half forward position, couples with the hammer latch raising bail, but is not in position to contact the hammer latch finger.

This is the means by which the points (representing commas), used to separate groups of three figures in a whole number, are printed. The two short prongs permit the printing of two such points.

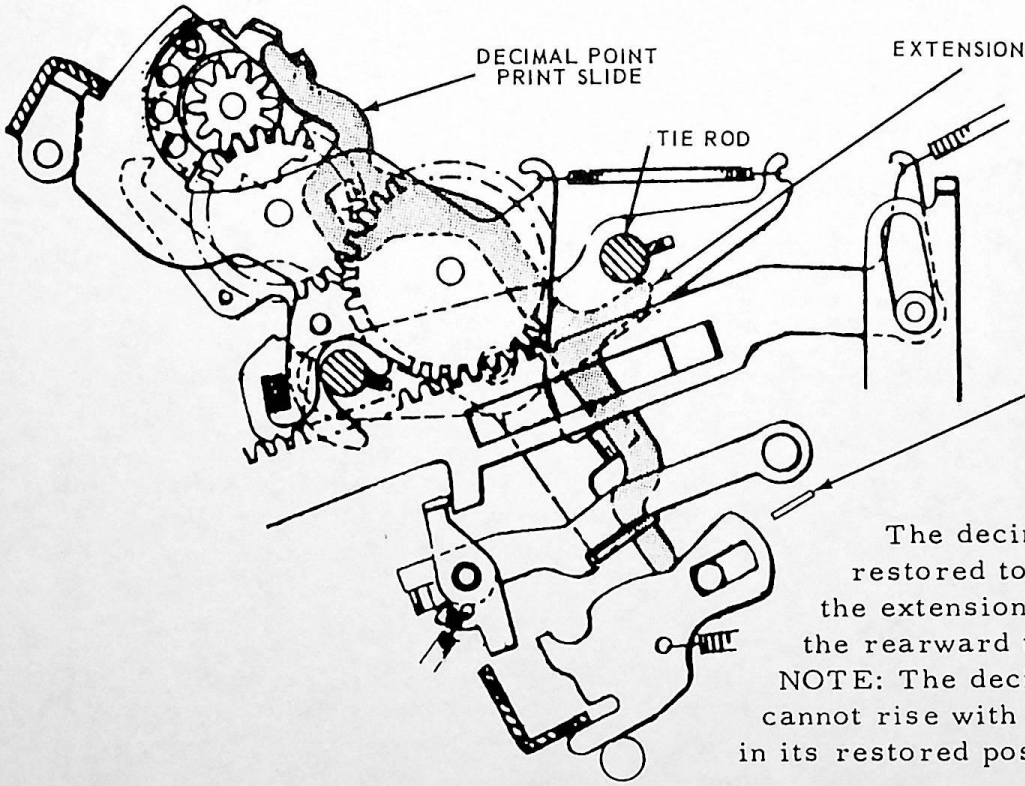
Printing the Zeros to the Left

With the front rack in normal (zero) position, the hammer latch finger is out of the path of the hammer latch raising bail. The decimal control finger (plastic) in its full forward position, engages the hammer latch raising bail and raises the hammer latch. Example: (Dec. 2-2) 0.0001 The raising of the hammer latch in the 5th column to print the zero, also raised the 4 other hammer latches to its right, even though the hammer latch in the column of the digit one was also raised by the hammer raising bail.

NOTE: The decimal point print slide is held in its down position by the rearward tie rod.


REARWARD TIE ROD
Front Rack (At Zero)
Decimal Selecting Slide (Forward)
Hammer Latch Finger
DECIMAL CONTROL FINGER (FULL FORWARD POSITION)
Hammer Latch Raising Bail

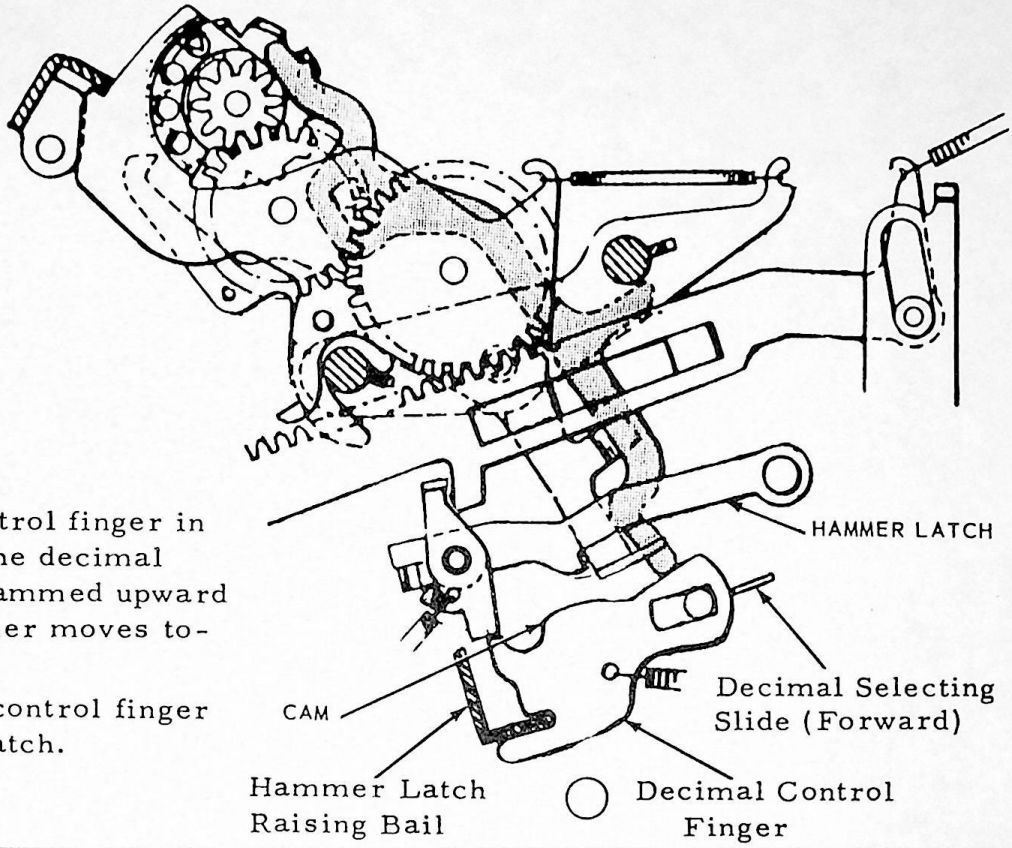
Decimal Point Print Slide Normal Position



The decimal point print slide is restored to its normal position by the extension on the slide contacting the rearward tie rod.

NOTE: The decimal point print slide cannot rise with the printing hammer in its restored position.

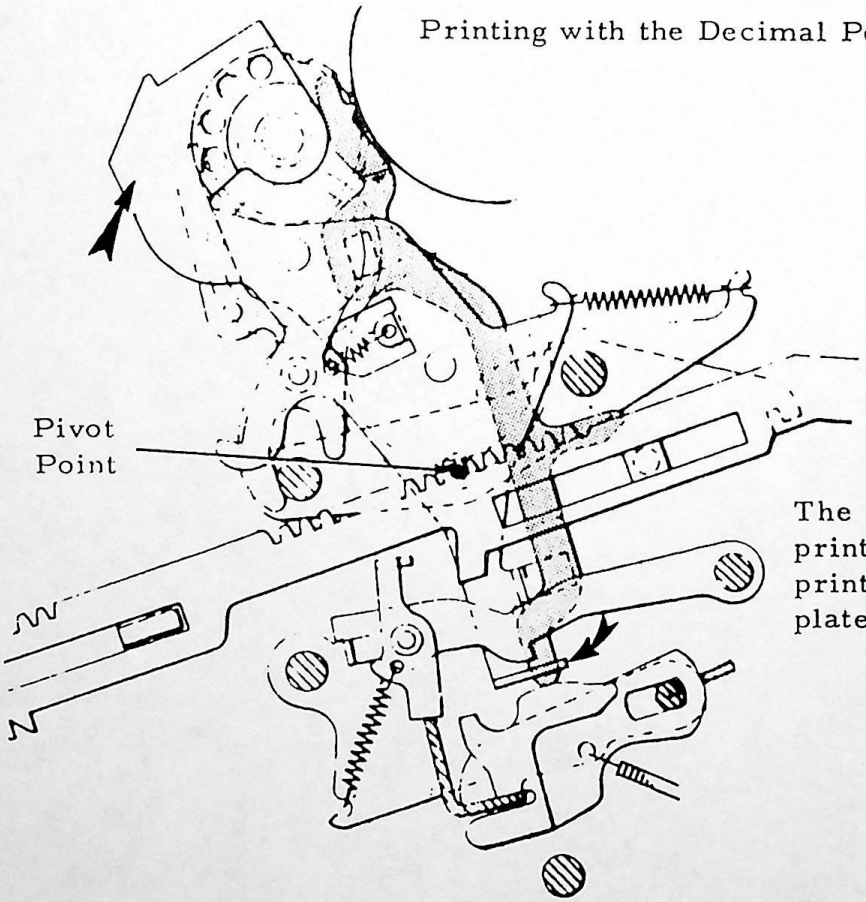
Raising the Decimal Point Print Slide



With the decimal control finger in the raised position, the decimal point print slide is cammed upward as the printing hammer moves toward the platen.

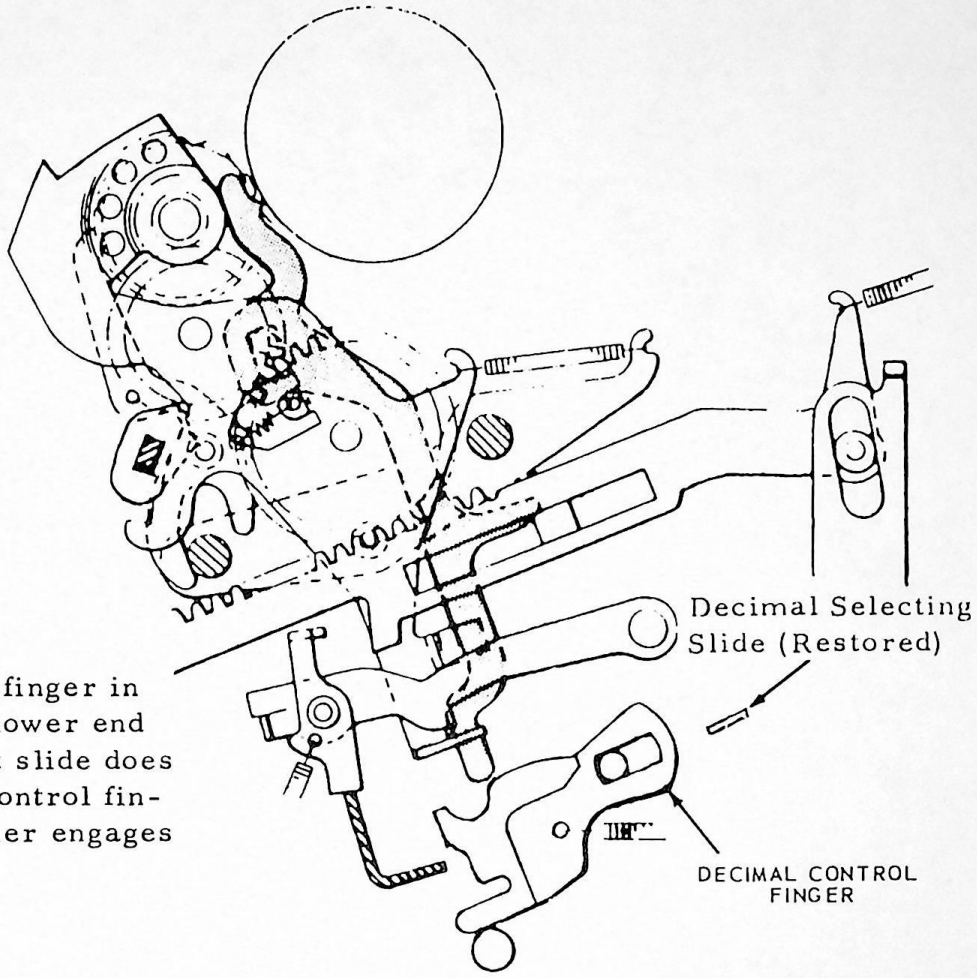
NOTE: The decimal control finger raised the hammer latch.

Printing with the Decimal Point



The lower end of the decimal point print slide cammed upward as the printing hammer moved toward the platen.

Printing without the Decimal Point

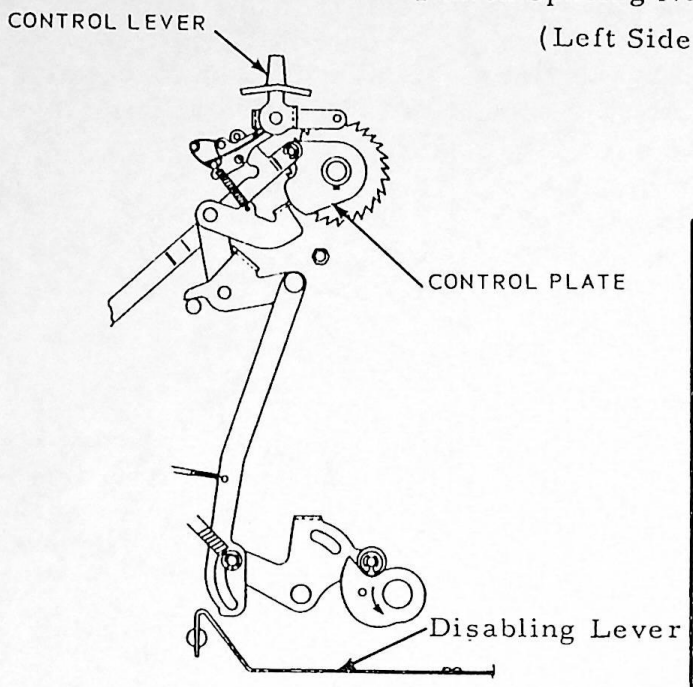


With the decimal control finger in its normal position, the lower end of the decimal point print slide does not contact the decimal control finger as the printing hammer engages the platen.

NOTES

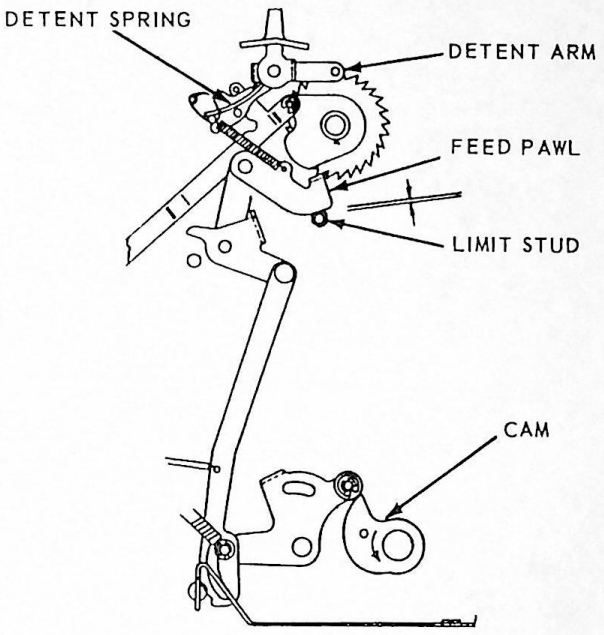
Platen Spacing Normal Position

(Left Side View)



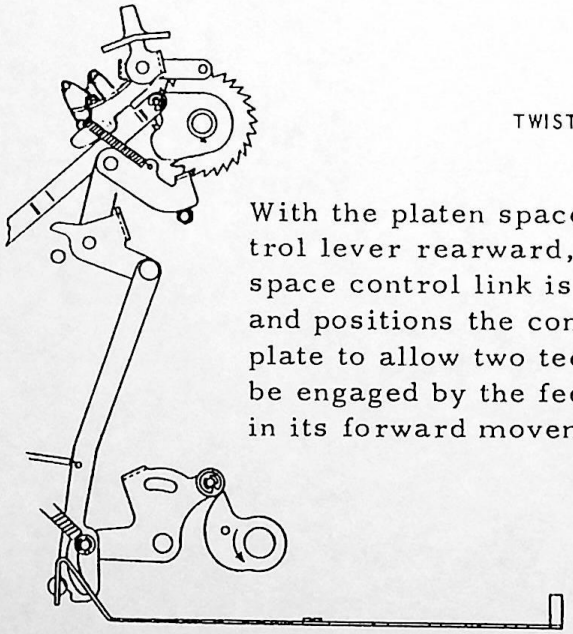
With the platen space control lever in the forward position, the control plate is positioned downward.

Single Space Position



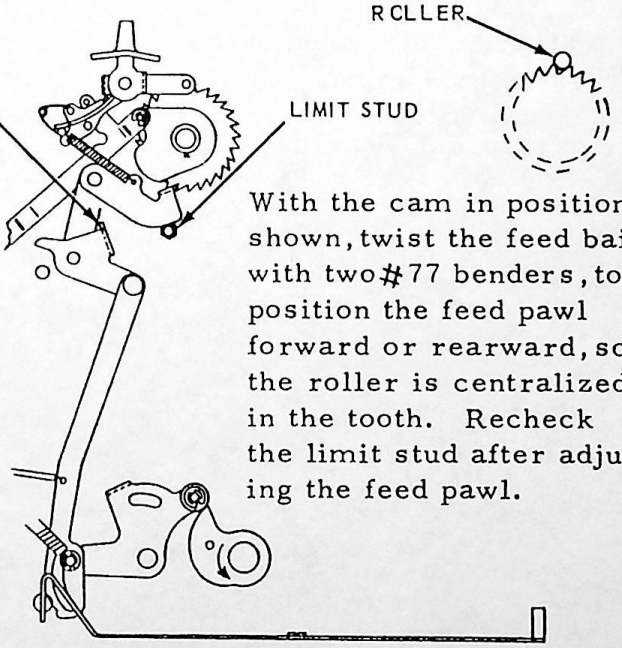
With the cam in position shown and the roller detent arm in the ratchet gear tooth, adjust the limit stud for slight clearance with the feed pawl.

Double Space Position



With the platen space control lever rearward, the space control link is raised and positions the control plate to allow two teeth to be engaged by the feed pawl in its forward movement.

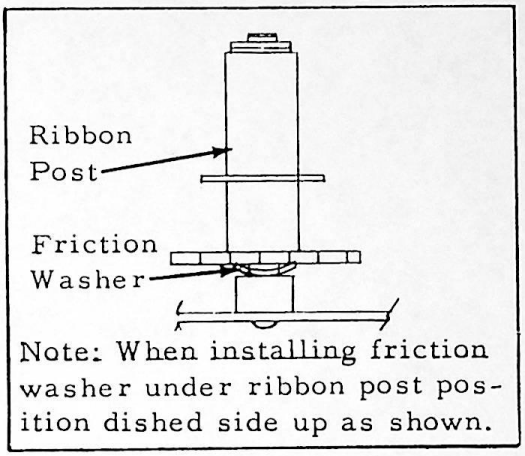
Centralizing the Detent Roller Arm



With the cam in position shown, twist the feed bail with two #77 benders, to position the feed pawl forward or rearward, so the roller is centralized in the tooth. Recheck the limit stud after adjusting the feed pawl.

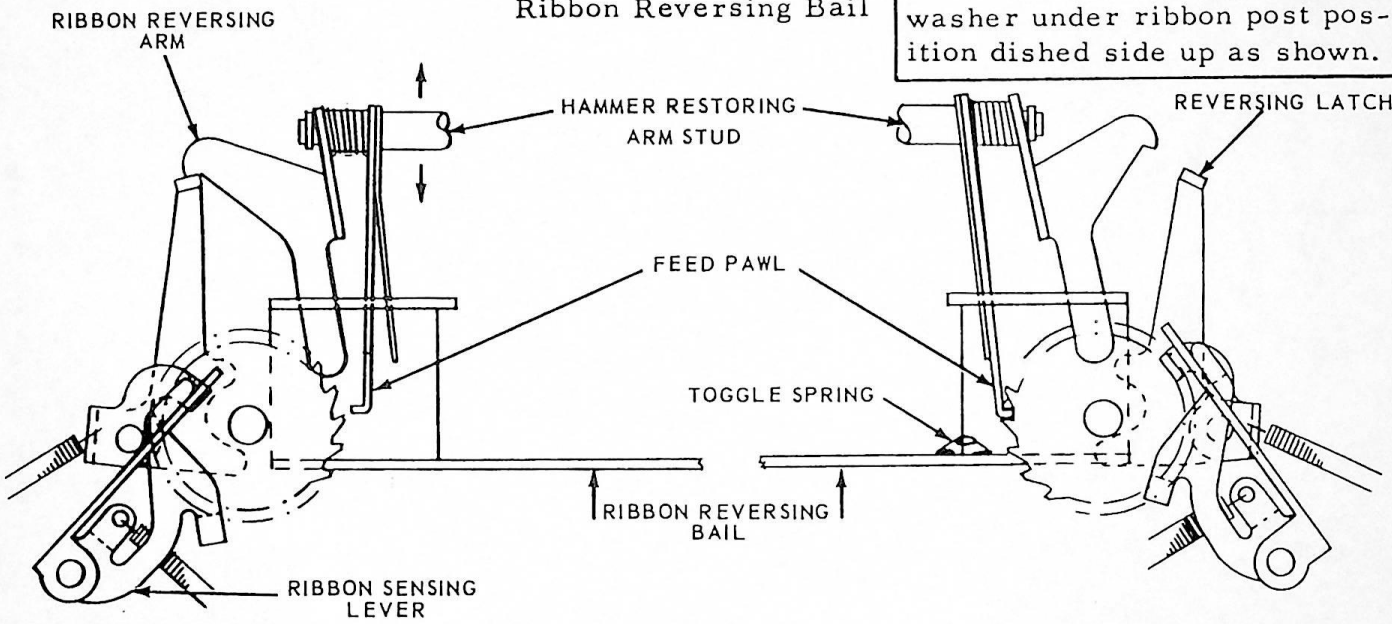
Ribbon Reverse

With the ribbon reversing bail positioned to the right, the right feed pawl is active. When the left hand ribbon spool has emptied far enough, it allows the sensing lever to engage the reversing latch...positioning the latch to engage the reversing arm. The reversing arm, on its forward movement, engages the reversing latch and positions the reversing bail to the left. The reversing bail in its movement to the left, disengages the right feed pawl and engages the left feed pawl. The left feed pawl will operate until the right ribbon spool is empty enough to allow its sensing lever to engage its latch. Then the reversing bail will be shifted to the right.



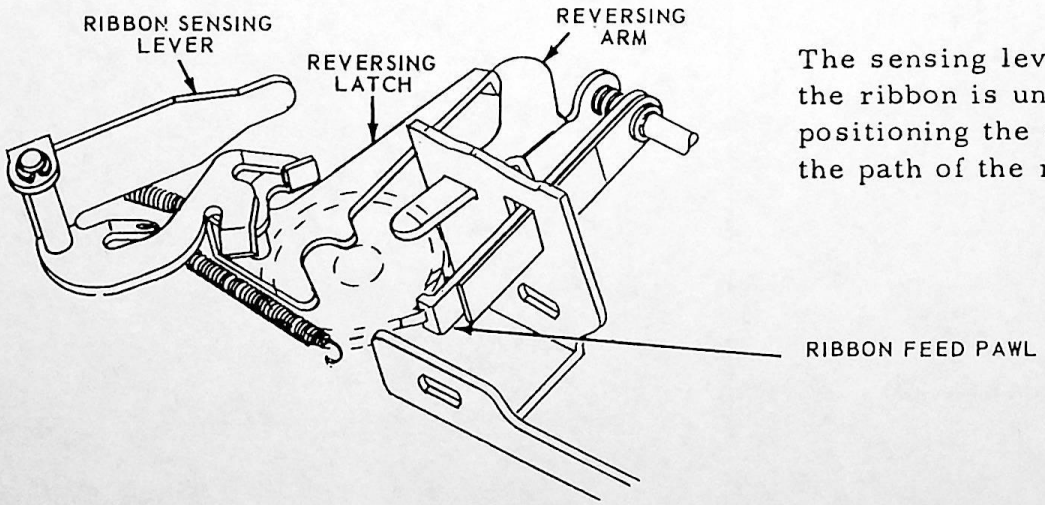
Note: When installing friction washer under ribbon post position dished side up as shown.

Ribbon Reversing Bail



The ribbon reversing bail positions the ribbon feed pawl to engage the ribbon spool gear teeth. A toggle spring holds the bail in either the right or left hand position.

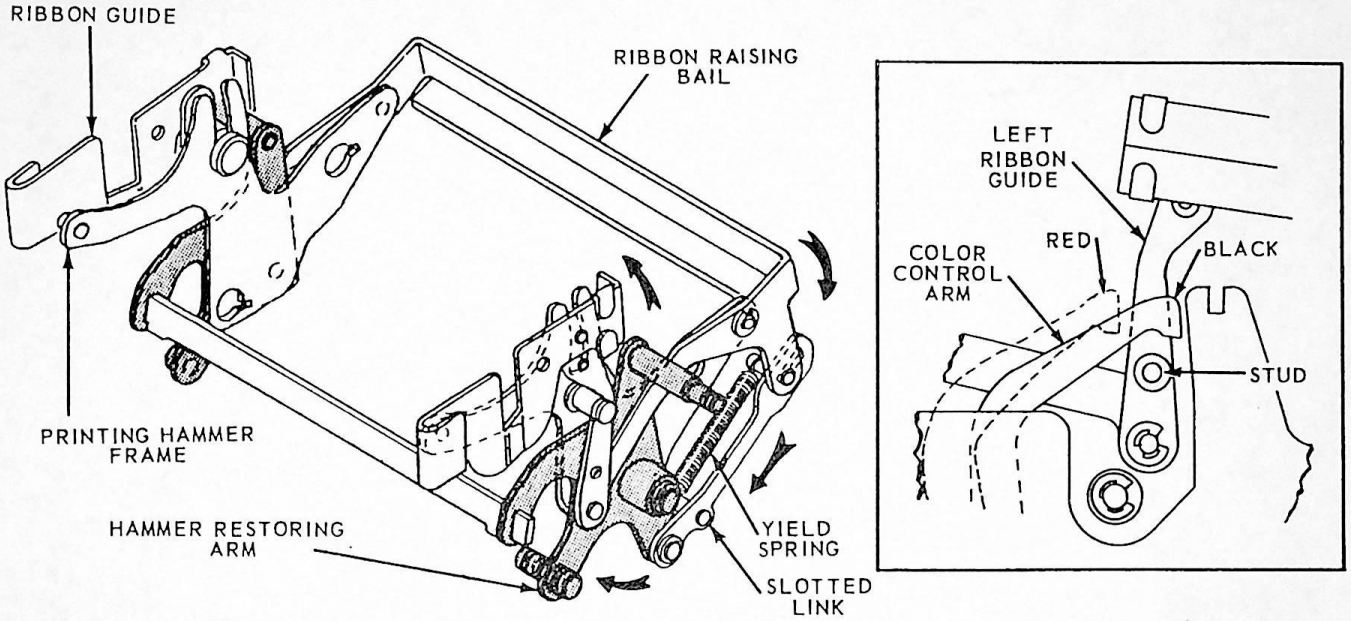
Ribbon Sensing Lever



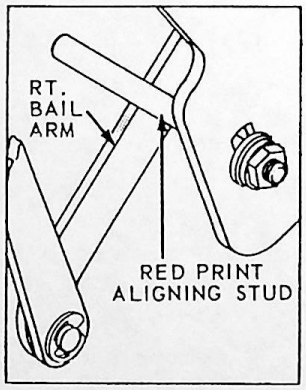
The sensing lever moves inward as the ribbon is unwound from the spool, positioning the reversing latch into the path of the reversing arm.

Ribbon Raising Bail

A slotted link with a yielding spring connects the ribbon raising bail to the right hammer restoring arm. When the restoring arms are rocked clockwise (as viewed from the right) on the first half of a cycle, the link is pulled forward. . . . Its spring, attached to the stud of the ribbon raising bail, pivots the bail clockwise. The forward ends of the ribbon raising bail, attached to the right and left ribbon guides, raise the ribbon guides which carry the ribbon.



In normal black print position, a stud on the left ribbon guide contacts the color control arm. . . stopping the upward movement of the ribbon raising bail and ribbon guides with the black band of the ribbon aligned between the print wheels and platen. The spring connecting the raising bail link to the right hammer restoring arm yields as the restoring arms continue their rocking motion to the hammer release position.

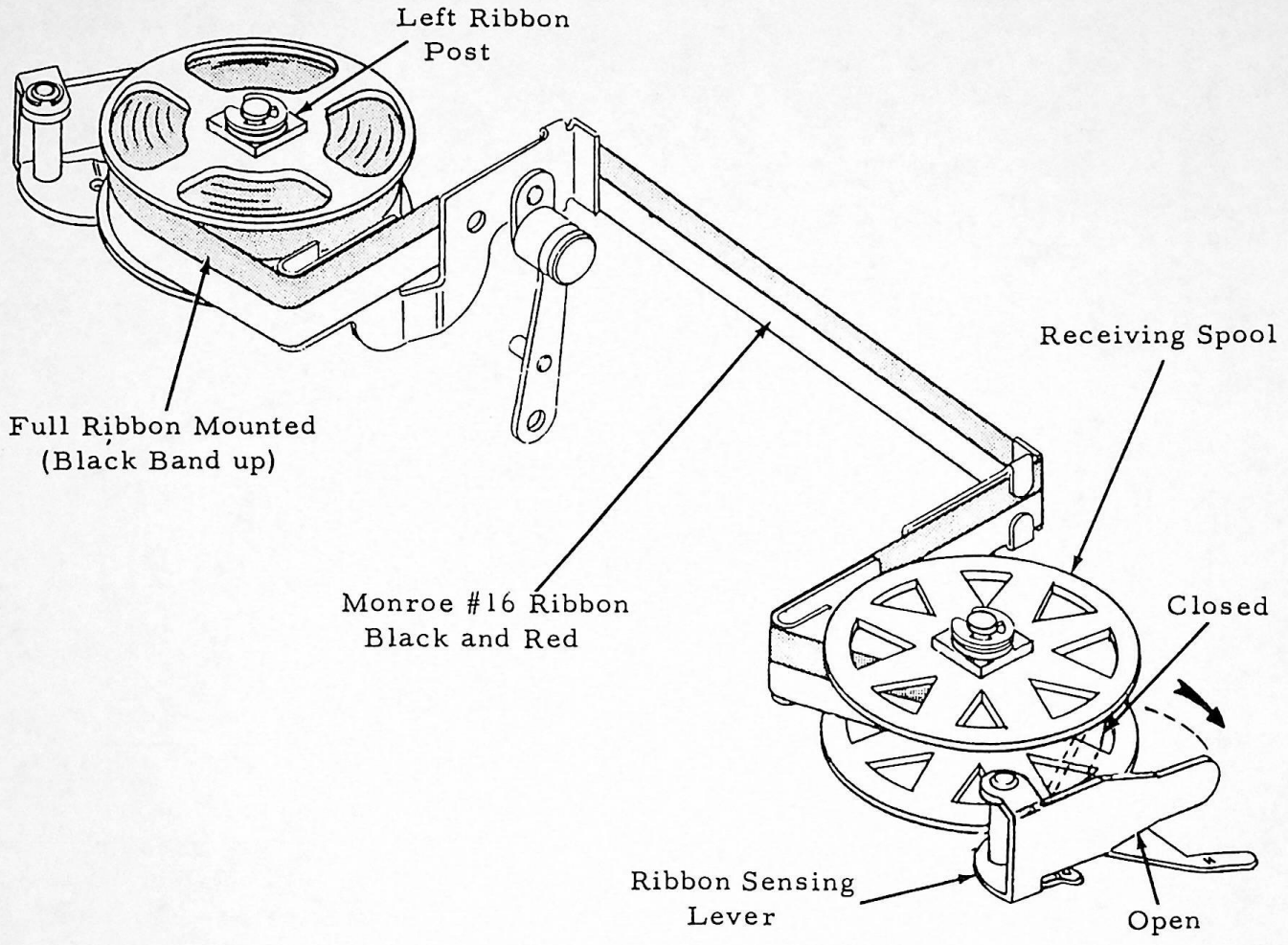


The lower end of the color control arm engages a slot in the red print/credit balance control slide. The red print/credit balance control slide can be moved forward by either the minus accumulator selection control bail or the accumulator total control bail. When the red print/credit balance control slide is moved forward, it pivots the color control arm out of the path of the stud on the left ribbon guide. The upward movement of the ribbon raising bail and ribbon guides, therefore, is not stopped by the color control arm. The ribbon raises until the right arm of the ribbon raising bail limits on the red print aligning stud which is located in the right end plate of the platen unit.

Adjustment

On a red print function, the red band of the ribbon should be horizontally aligned between the print wheels and platen so that the figures print fully in red. . . no black edge at the top. . . no "cut-off" at the bottom. Adjust red print aligning stud up or down in its slot as required.

Ribbon Installation

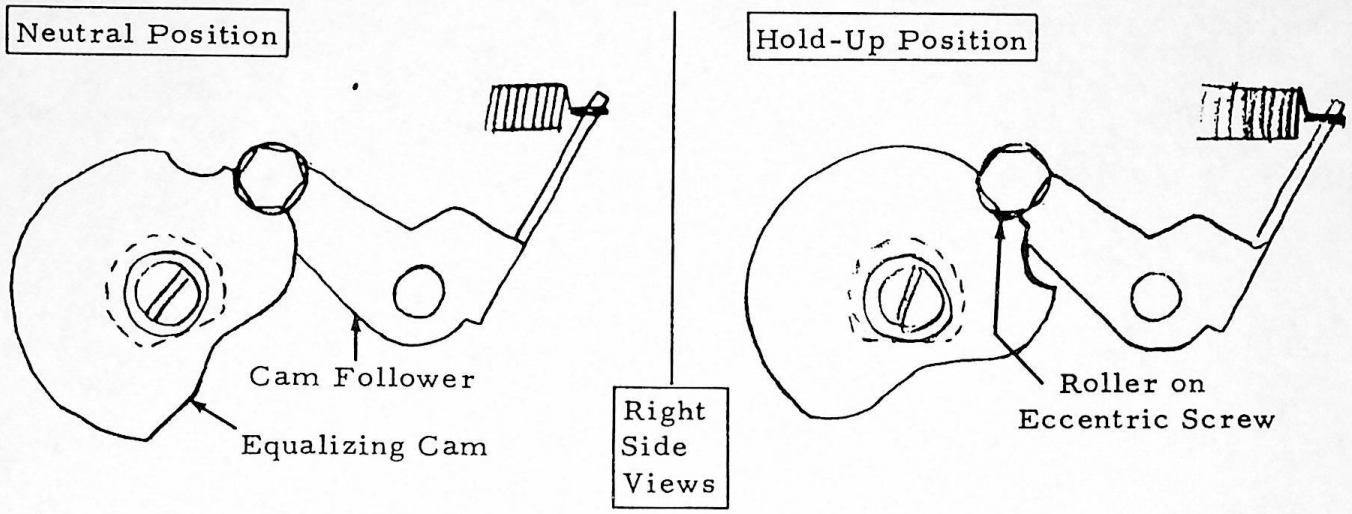


To install a new ribbon, swing both ribbon sensing levers outward until they detent in the "open" position. Remove the old ribbon from the machine.

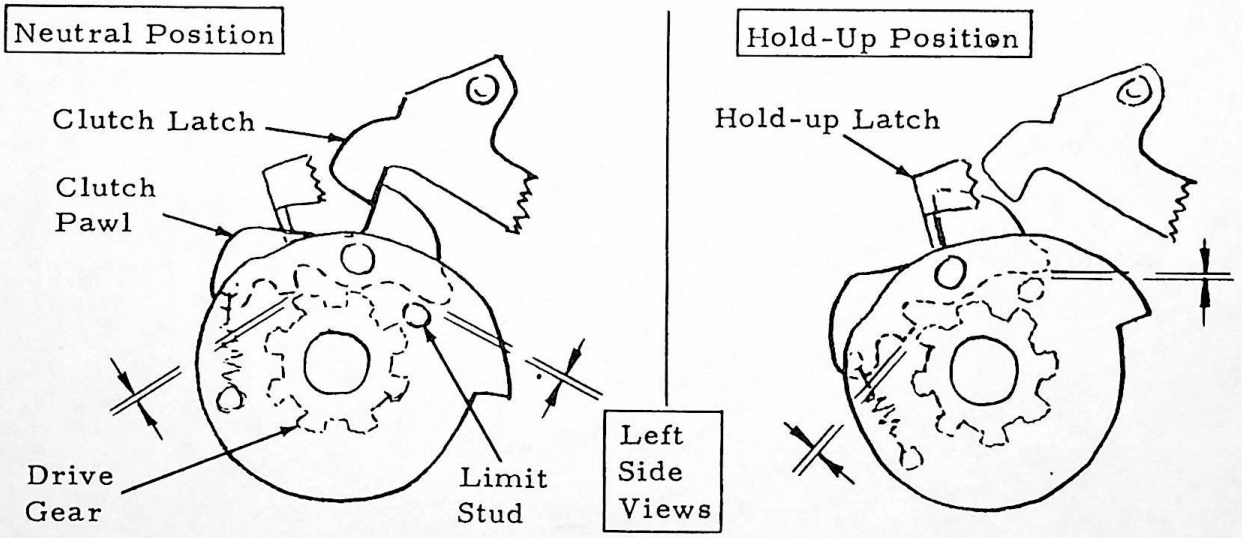
The new ribbon must be mounted on the left ribbon post to properly position the red and black bands of the ribbon. Before placing the ribbon on the ribbon post, unwind enough ribbon (10 to 12 inches) to be threaded through the guides to the receiving spool on the right side. Thread the ribbon through the guides as shown in the illustration above. Position the ribbon retaining clip into the space provided on the spool. Install the spool. Move the sensing levers into "closed" position (against the ribbon).

Equalizing Cam

The equalizing cam is located on the extreme right end of the main cam shaft. It contains two detent notches. . . one for locating the main cam shaft in neutral position . . . the other for locating the shaft in hold-up position. The other contours of the cam are designed to balance the loading and unloading action of other cams on the main shaft.



The equalizing cam follower roller is mounted on an eccentric screw to provide a means of accurately setting the detented positions of the main shaft.

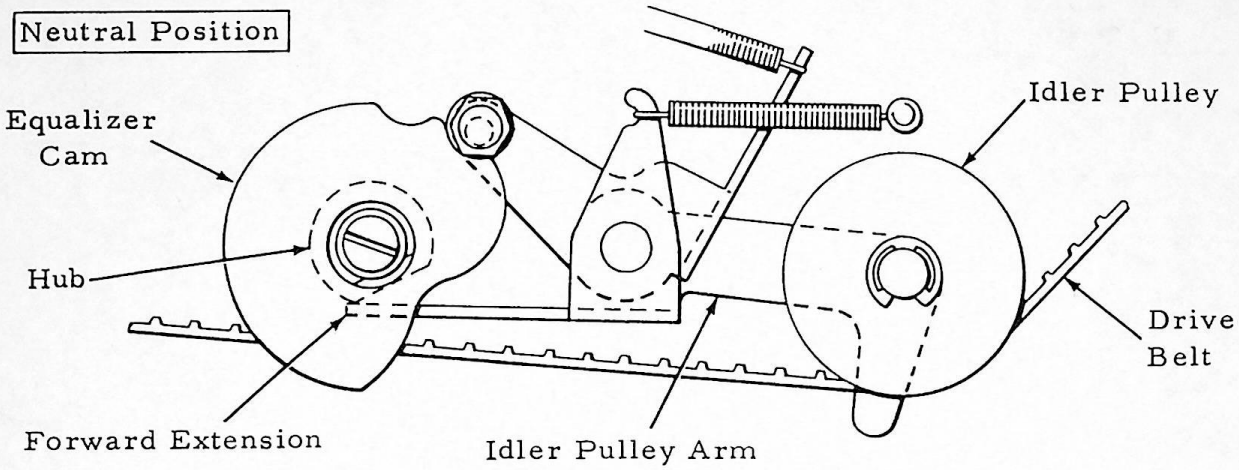


Adjustment

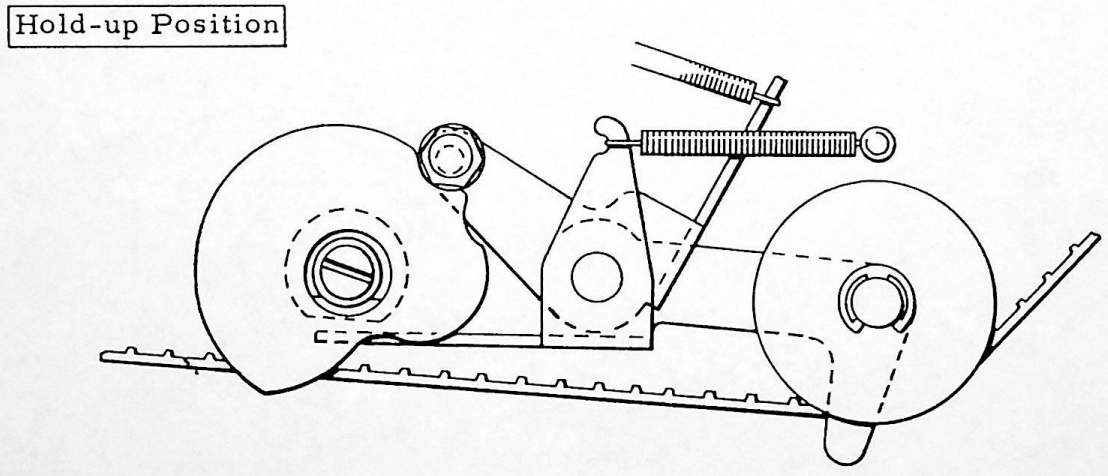
The main cam shaft clutch pawl should have clearance at the teeth of the clutch drive gear (so that the clutch doesn't chatter), and clearance at the limit stud (so that the clutch is not cramped). These two clearances should be evident in both the neutral and hold-up positions of the main cam shaft. Adjust eccentric screw for cam follower roller as required.

Idler Pulley Arm

The idler pulley for the rear unit drive belt is mounted on a spring loaded arm. This keeps the belt under spring tension when it is driving the high speed mechanism. It also provides a yeilding point which will permit the belt to slip over the shallow teeth of the front drive pulley in the event of a jam in the high speed mechanism.

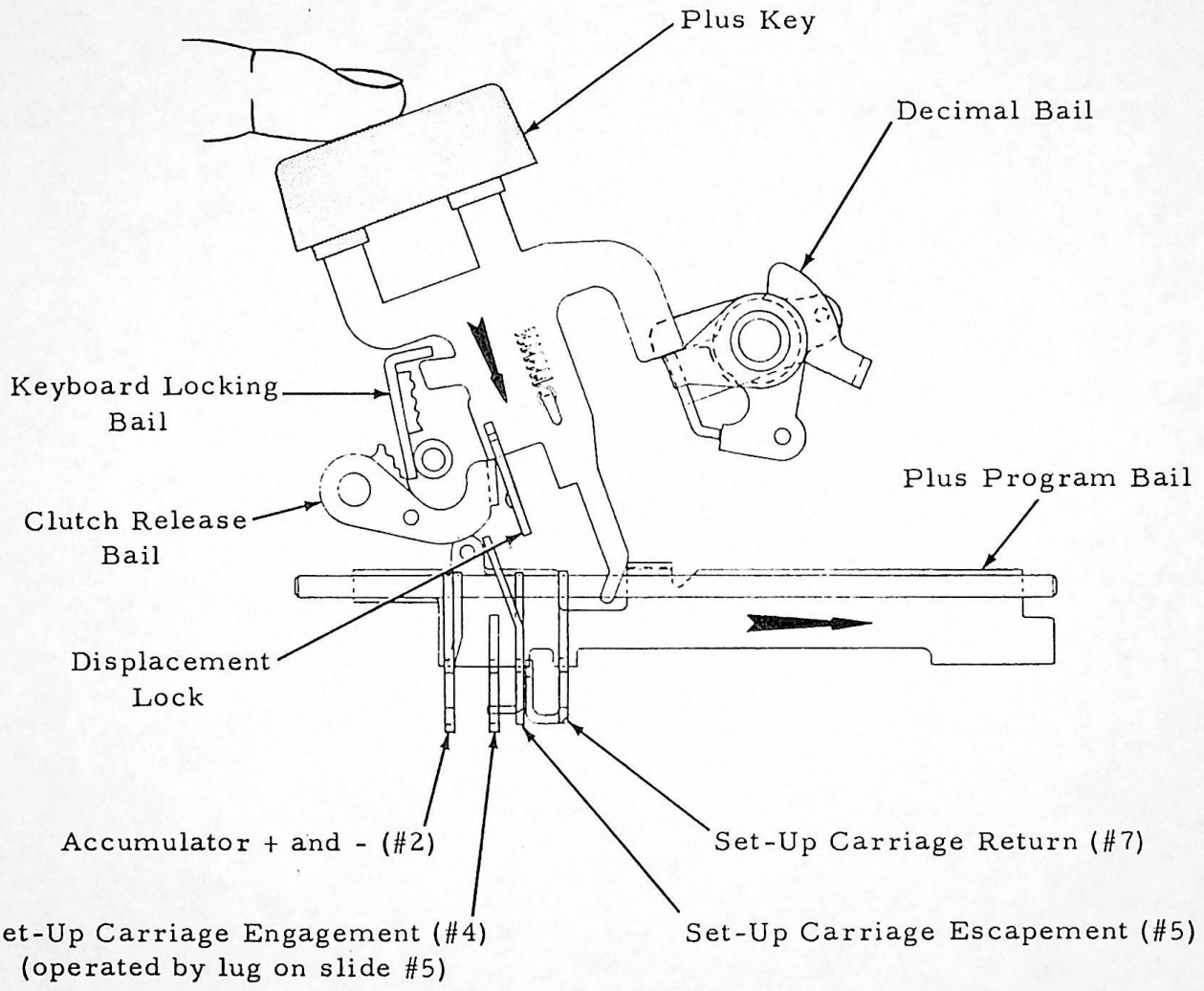


The spring loaded pulley arm has a forward extension which rides on the hub of the equalizer cam. This is intended to relieve most of the spring tension from the belt when the high speed mechanism is not operating. A flat area on the hub positions over the pulley arm extension, tensioning the belt, when the main cam shaft is in "hold-up" position.



Adjustment

The forward extension of the spring loaded pulley arm should just touch the hub with main cam shaft in neutral position.... There should be a very slight clockwise pivoting of the pulley arm when the main shaft is cycled to hold-up position.... Adjust by forming forward extension of pulley arm.


Plus Key
Decimal Bail
Keyboard Locking Bail
Clutch Release Bail
Plus Program Bail
Displacement Lock
Accumulator + and - (#2)
Set-Up Carriage Return (#7)
Set-Up Carriage Engagement (#4) (operated by lug on slide #5)
Set-Up Carriage Escapement (#5)

Depression of the plus key operates the keyboard locking bail, clutch release bail and decimal bail... and engages the displacement lock. The plus keystem also pushes the plus program bail into engagement with the program feed plate.

As the program feed plate is driven to the left during the first 24° of the main cam shaft rotation, the plus program bail activates the following program slides:

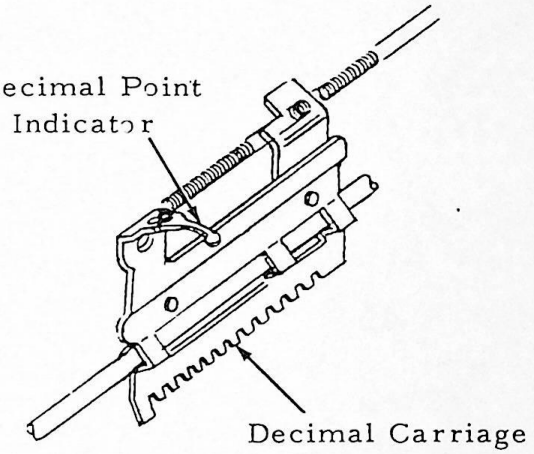
Accumulator plus and minus (#2)
Set-up Carriage Escapement (#5)
which operates Set-up Carriage Engagement (#4)
Set-up Carriage Return (#7)

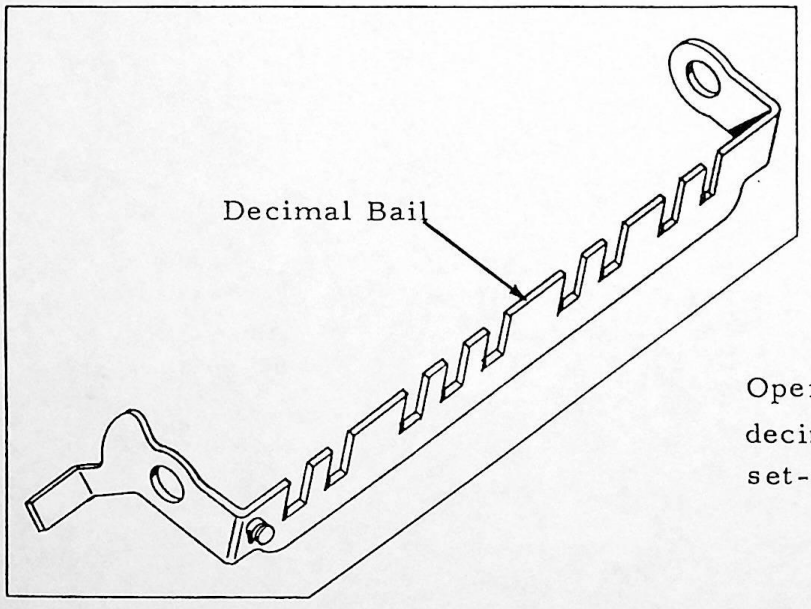
Three of the items listed above have not been described previously.... They are:

The Decimal Bail
The Set-up Carriage Escapement Program Slide (#5)
The Accumulator Plus and Minus Program Slide (#2)

Decimal Bail

You have no doubt observed the function of the decimal point indicator (yellow dot) that operates in conjunction with the set-up carriage. This indicator is mounted on a sliding member in the decimal unit which we will call the "decimal carriage".

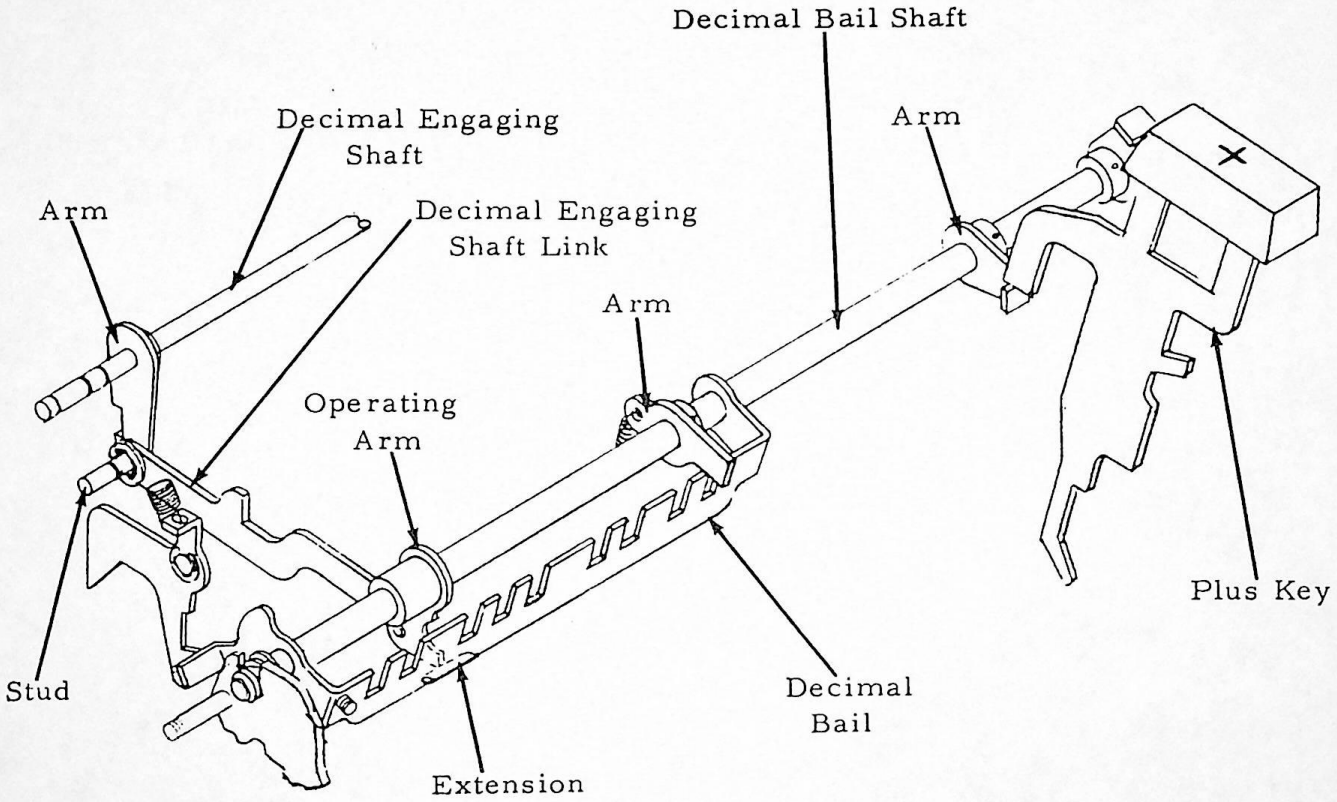




Operation of the decimal bail causes this decimal carriage to be connected to the set-up carriage.

The decimal bail can be operated manually by depression of the decimal key.... It is operated automatically whenever the plus, minus, enter multiplicand*, enter dividend*, division or any of the multiplication keys are depressed.
*Note: except transfers.

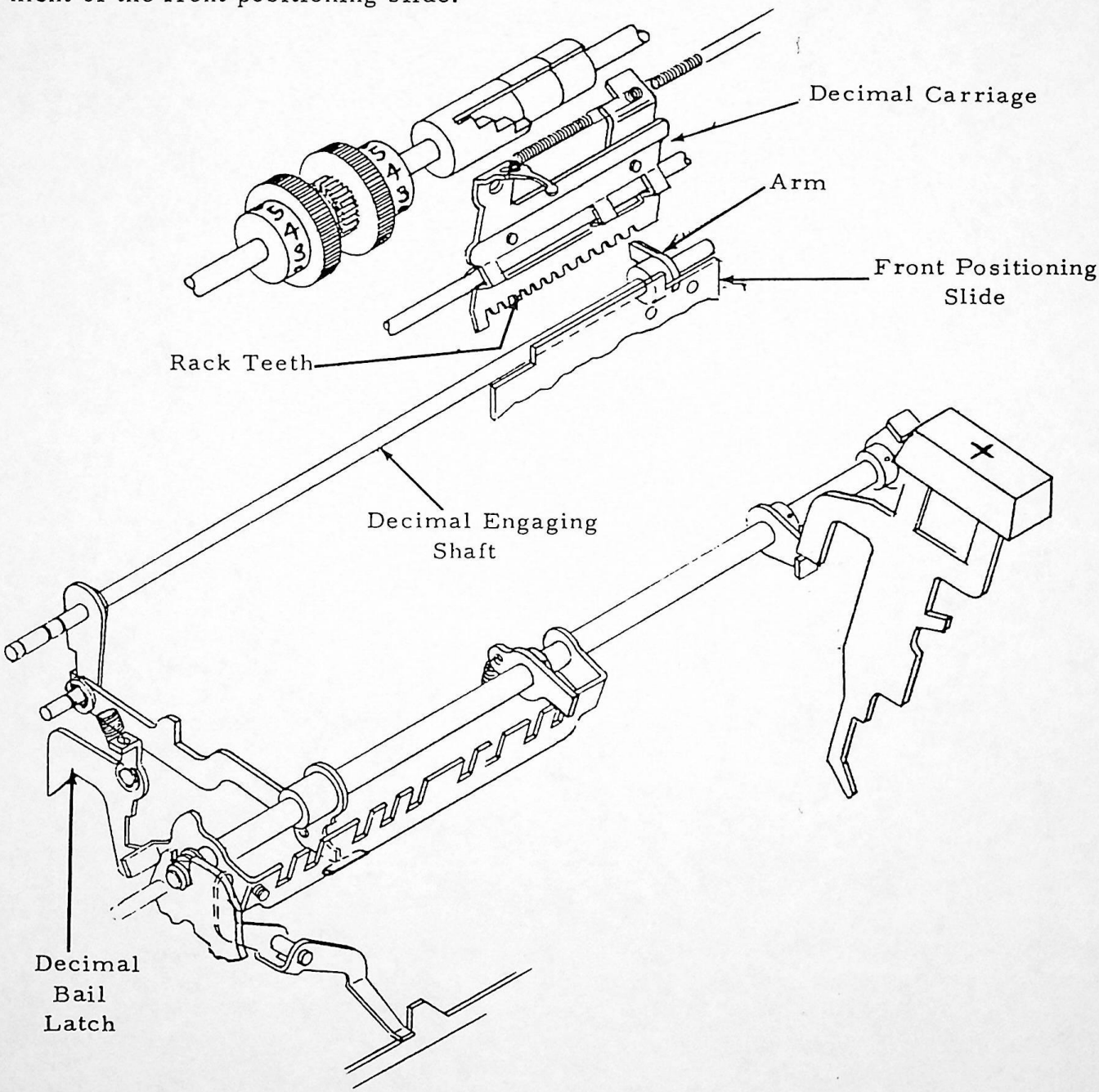
When the plus key is depressed, an extension on the plus keystem contacts an arm, which is pinned near the right end of the decimal bail shaft... pivoting the shaft. (Note: This arm is also operated by the minus key.) Another arm is pinned to the shaft inside the decimal bail and extends forward over the top of the bail. As the shaft pivots, this arm pivots the decimal bail.



As the decimal bail pivots an extension on its lower edge contacts the operating arm for the decimal engaging shaft link... pushing this link to the rear. The link is connected to a stud on an arm on the left end of the decimal engaging shaft.

Another arm is keyed to the decimal engaging shaft near its right end. This arm is trapped between two studs on the vertical section of the front positioning slide for the set-up carriage.

This arm therefore slides left and right on the decimal engaging shaft with the movement of the front positioning slide.

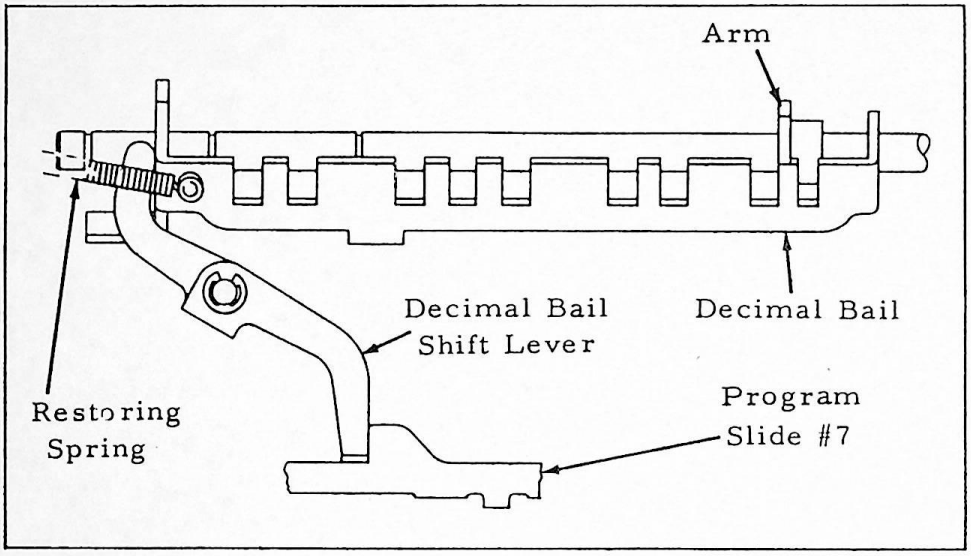


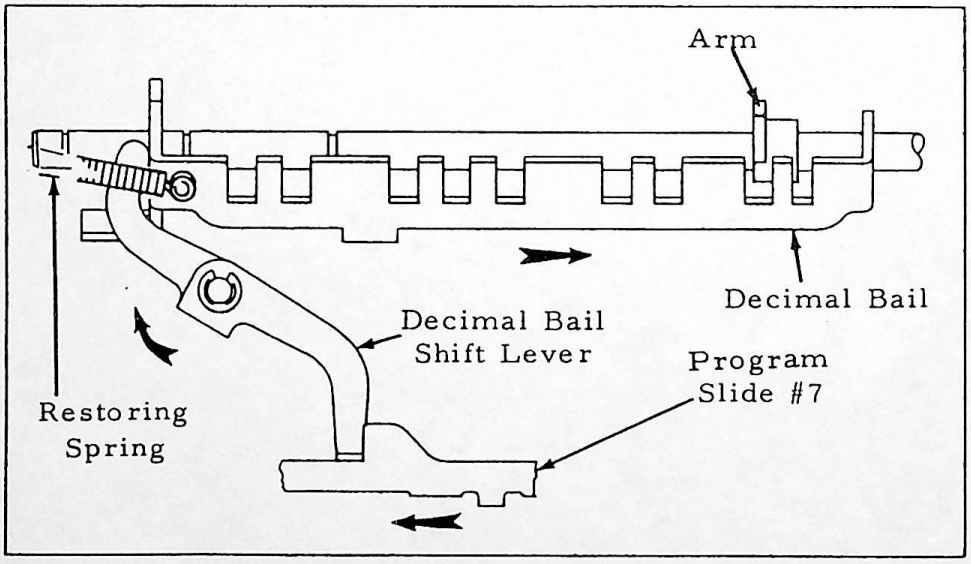
As the decimal engaging shaft is pivoted by the action of the decimal bail, the beveled edge of this arm is pivoted into engagement with the rack teeth on the lower edge of the decimal carriage... thereby forming the connection between the decimal carriage and set-up carriage.

Therefore, any subsequent movement of the set-up carriage to the left after engagement of the decimal bail will cause the decimal carriage to move with it.

As the decimal bail pivots fully, an extension on its left end is engaged by the decimal bail latch. This latch will hold the decimal bail activated until the start of the set-up carriage return movement (Note: The unlatching of the decimal bail was described previously on Page IV-C-19).

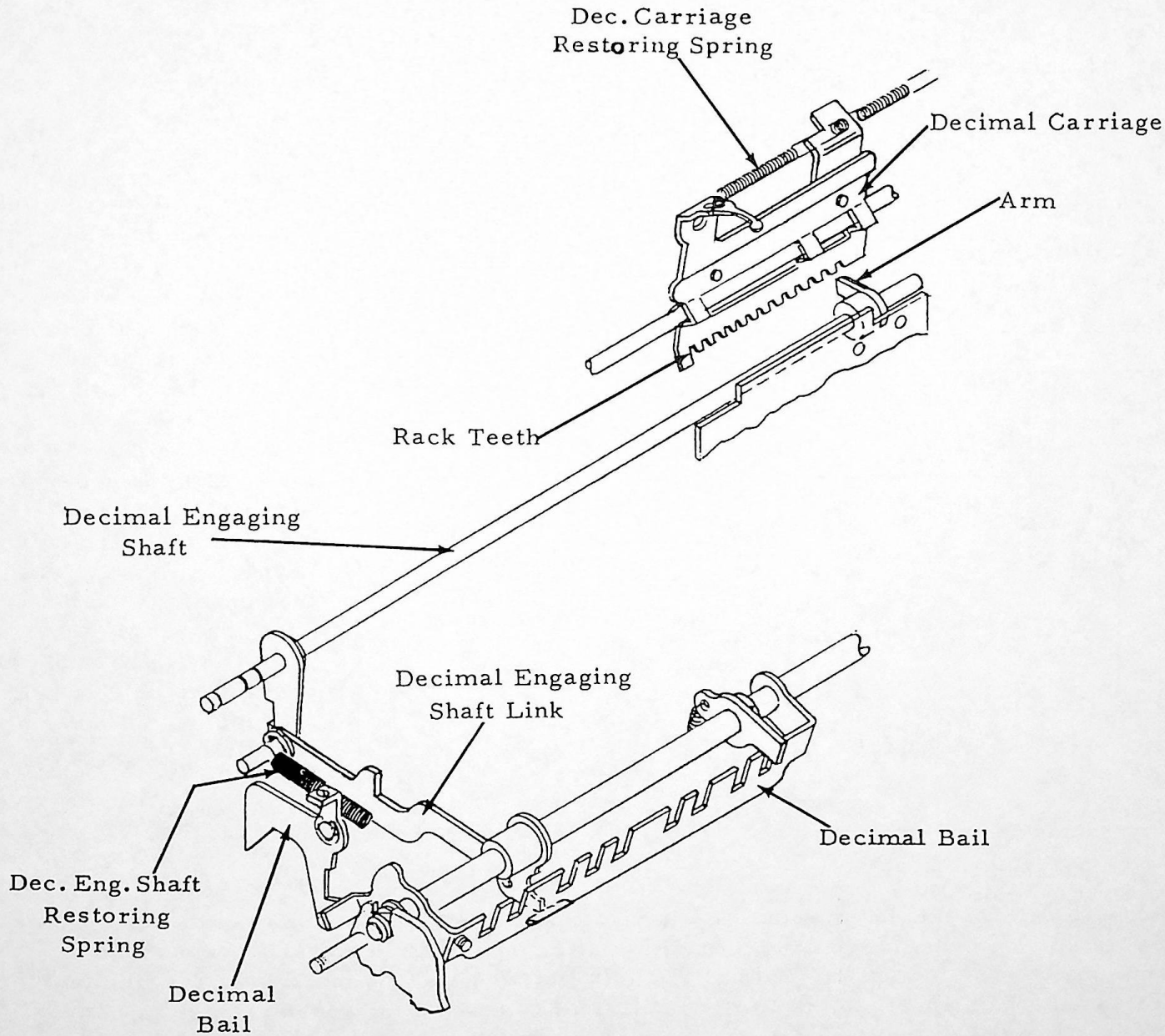
Note that the decimal bail contains a number of notches along its upper edge. These notches are located to the left of the various keystems and the arm operated by the plus and minus keystems. During the program feed part of the machine cycle (first 24°) the set-up carriage return program slide (#7), in its movement to the left, pivots the decimal bail shift lever. The upper end of the decimal bail shift lever contacts the left end of the decimal bail... shifting the bail to the right. In this position one of the notches in the bail aligns under the arm that had pivoted the bail. The bail is thus released from the control of the function key but it cannot pivot back to normal position since it is held by the decimal bail latch.





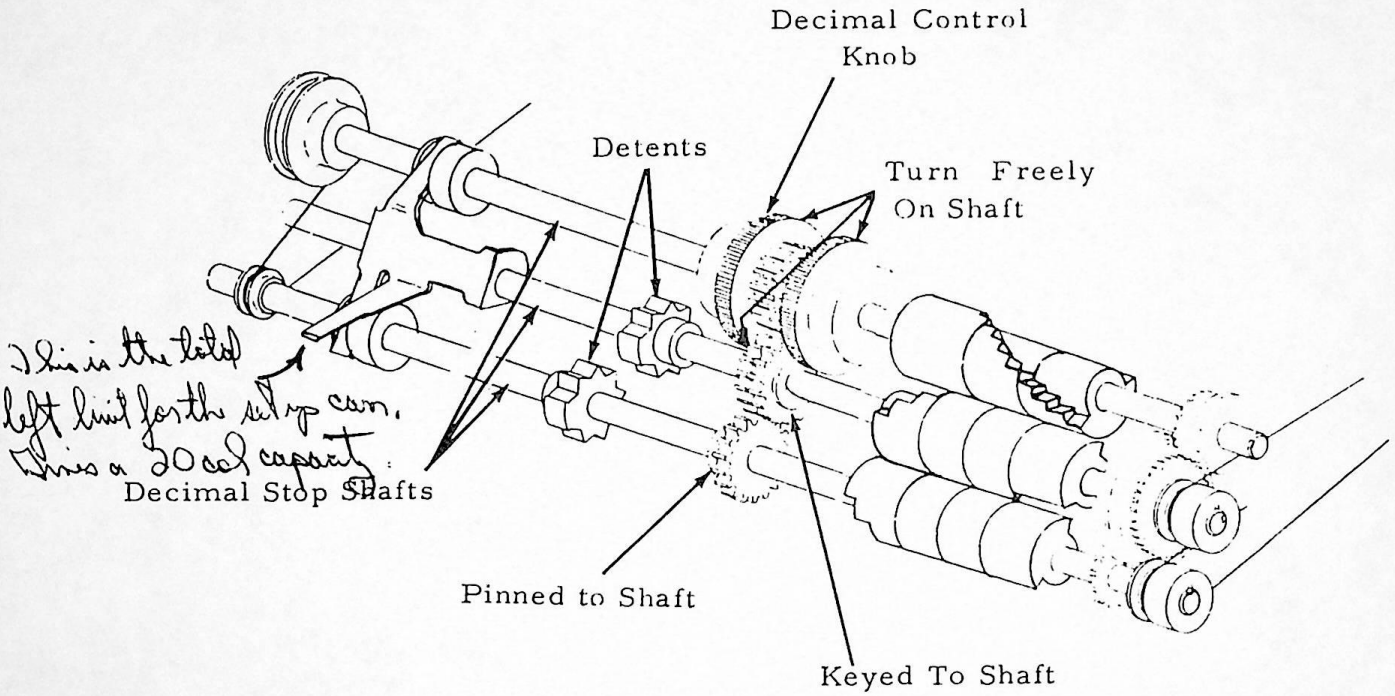
This shifting of the decimal bail to the right is done so that the bail can be restored by its spring to its normal radial position after its latch is released... even though the function key is still latched down at this time. When the function key is finally released, the same restoring spring pulls the bail to the left (normal lateral position) where the operating surfaces along its upper edge once again align under the keystems and plus/minus arm.

NOTE: The unlatching of the decimal bail (as described on Page IV-C-19) occurs before the start of the set-up carriage return movement. This unlatching and pivoting of the bail to its normal radial position releases the operating arm for the decimal engaging shaft link. This permits the decimal engaging shaft to be pivoted to its normal position by its restoring spring...thus moving the beveled edge of the arm on the right end of the shaft out of engagement with the rack teeth on the lower edge of the decimal carriage. The decimal carriage...now disengaged from the set-up carriage...is returned to the right by its restoring spring.



Decimal Control

There are three decimal stop shafts in the decimal control unit...the upper decimal stop shaft...the middle decimal stop shaft...and the lower decimal stop shaft. These three decimal stop shafts are tied together near their left end and will move right and left as a unit. The two decimal control knobs are located on the upper decimal stop shaft. They are free fitting on the shaft and, while turning a knob will cause the upper shaft to turn, it is through an indirect action...not a direct attachment.


Decimal Control Knob
Detents
Turn Freely On Shaft
This is the total left limit for the setup cam. Gives a 20 col capacity.
Decimal Stop Shafts
Pinned to Shaft
Keyed To Shaft

The gear of the right decimal control knob is engaged with a gear that is keyed to the middle decimal stop shaft. Therefore...the right knob turns the middle shaft.

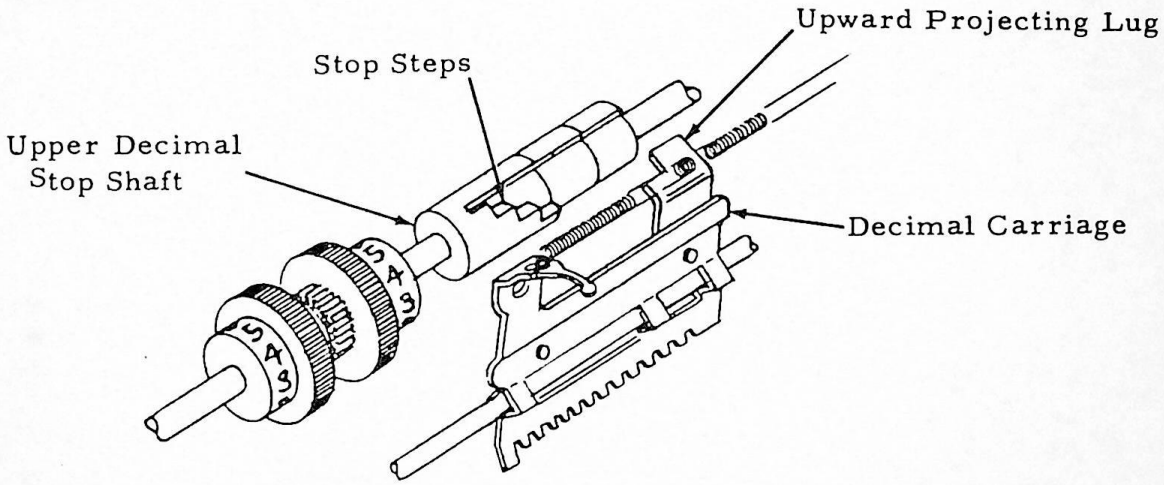
The gear of the left decimal control knob is engaged with an intermediate gear which turns freely on the middle decimal stop shaft....The intermediate gear turns a gear that is pinned to the lower decimal stop shaft. Therefore...the left knob turns the lower shaft.

A planetary gear mechanism on the right end of the middle shaft causes the upper shaft to turn when either the middle or lower shaft is turned.

The middle and lower shafts each have a detent (ball plunger) arrangement to keep them positioned according to the setting of their respective decimals control knobs. Since the upper shaft is positioned by both of the others...it relies on their detenting for its proper location and its total detented movements away from "home" (zero decimal) position is an accumulation of the movement of the other two shafts.

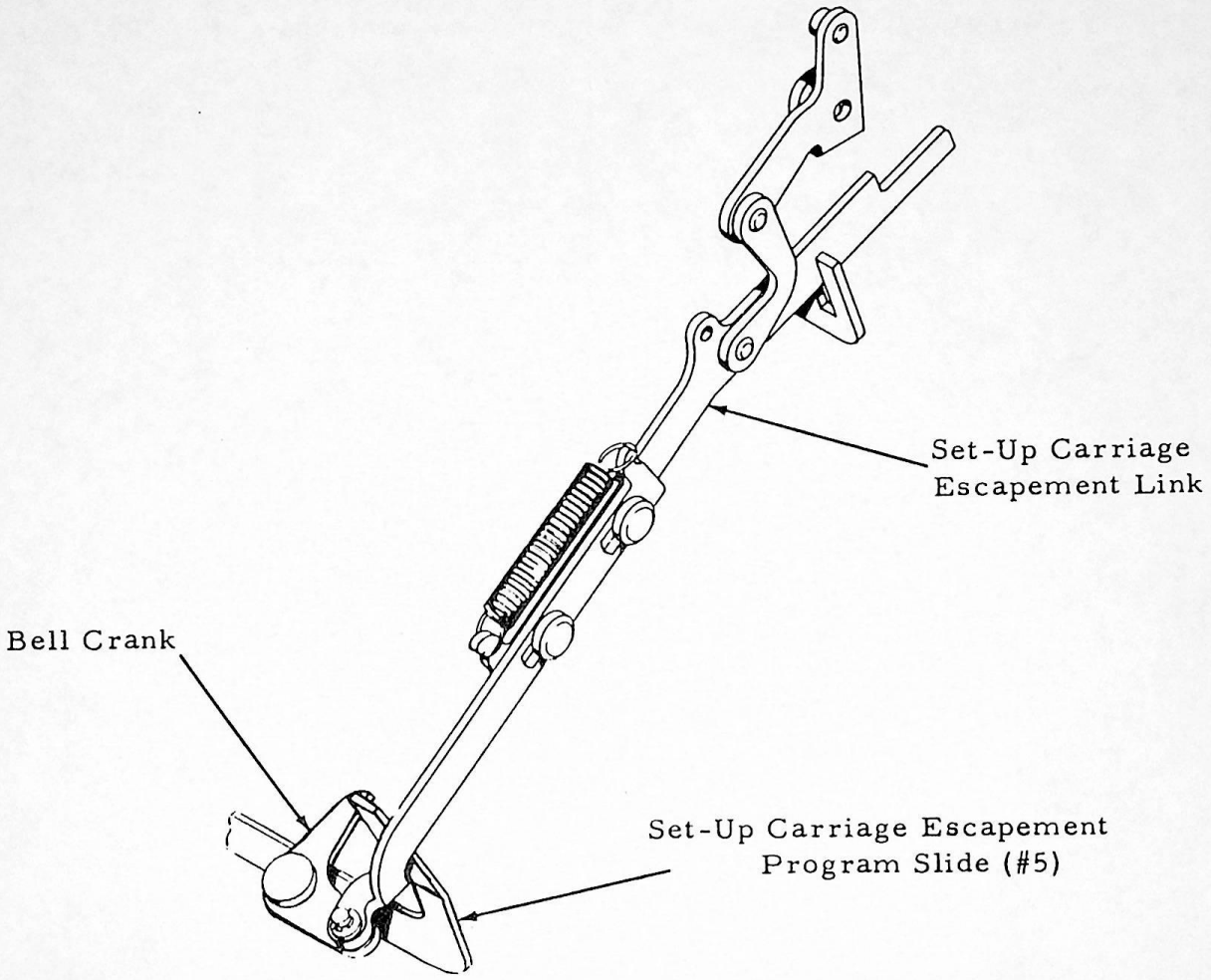
The "stops" of these decimal stop shafts are a group of moulded plastic parts containing stop steps. The middle and lower stop shafts have two sets of stop steps... one facing left...the other facing right. The middle decimal stop shaft is also called the selector decimal stop shaft and it will be described fully under "Enter Multiplicand Key"....The lower decimal stop shaft is also called the multiplier decimal stop shaft and it will be described fully under "Multiplication Key".

The upper decimal stop shaft is used on plus, minus and enter dividend (except transfer dividend) operations. It has only one set of stop steps and these face to the right.



The decimal carriage has an upward projecting lug on its right end. When the set-up carriage escapes to the left (this description follows) it moves until this upward projecting lug contacts one of the stop steps on the upper decimal stop shaft. The stop step which is contacted depends upon the setting of the decimal knobs. The stop steps have the same lateral spacing as the set-up carriage dials and front racks. Therefore, if the decimal dials are set at 4-4...the upper decimal stop shaft will have been detented 8 steps away from its zero decimal position. If no decimal amount was entered in the set-up carriage, it will escape eight columns to the left when the plus key is depressed before the decimal carriage lug contacts the appropriate stop step.

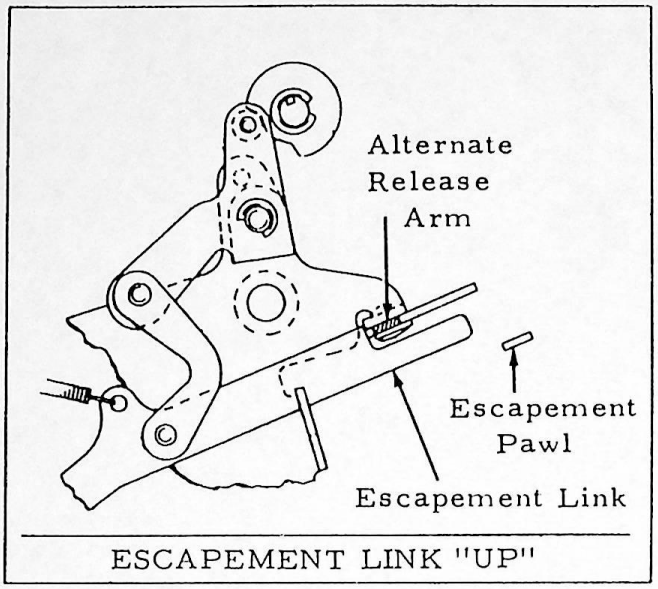
Set-up Carriage Escapement Program Slide (#5)



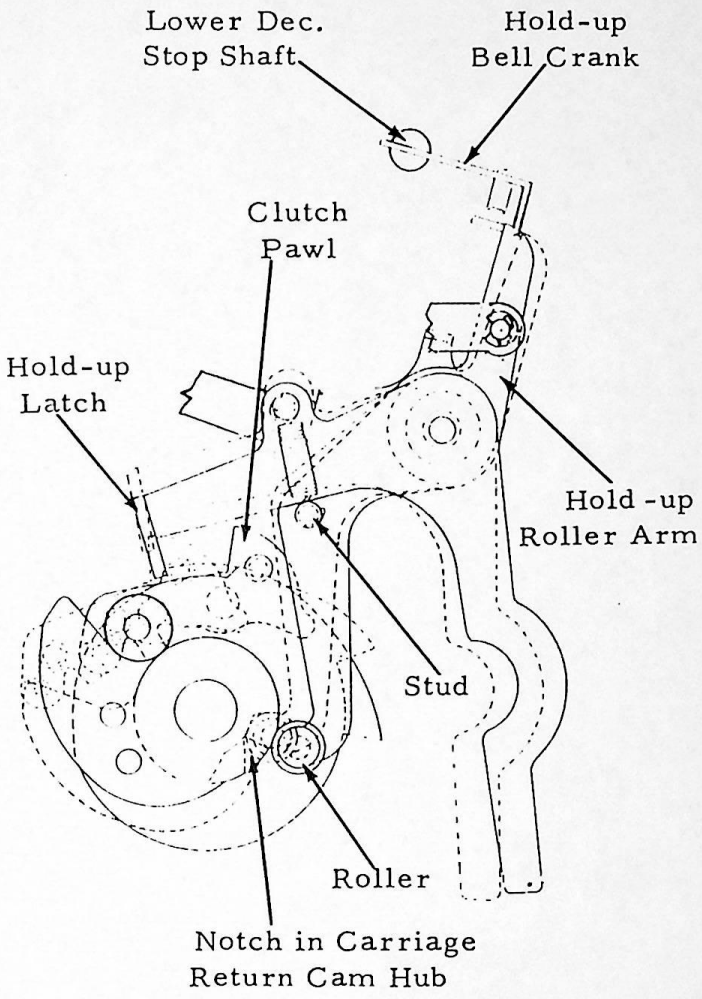
When the set-up carriage escapement program slide (#5) is moved to the left during the first 24° of the machine cycle, an upward extension on its right end pivots a bell crank which pushes the set-up carriage escapement link to the rear. This escapement link has two positions...up or down. It is in the up position when less than a total of three decimals have been set at the decimal knobs. It is cammed to the down position when a total of three or more decimals have been set at the knobs.

> NOTE: This arrangement is provided to permit the use of standard adding machine punctuation (dollars and cents) for add and subtract applications without the necessity of depressing the decimal bar on each entry. In such cases the decimal knobs would be set at 1-1. It should be noted that decimal zeros will not be entered automatically with this setting...they must be entered thru the keyboard.

The escapement link is actually two links connected by a pair of studs which pass thru slots in the forward link and are riveted to the rearward link. The links are extended to full length by a spring. This permits the link to yield when required.



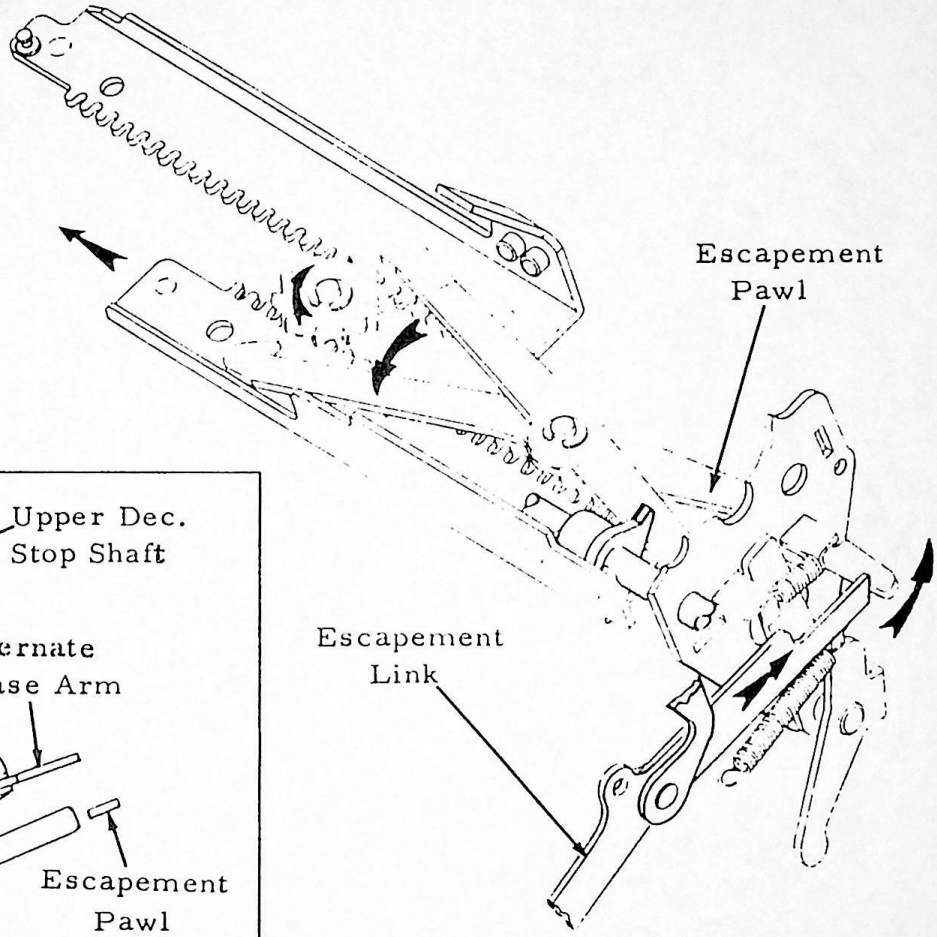
ESCAPEMENT LINK "UP"

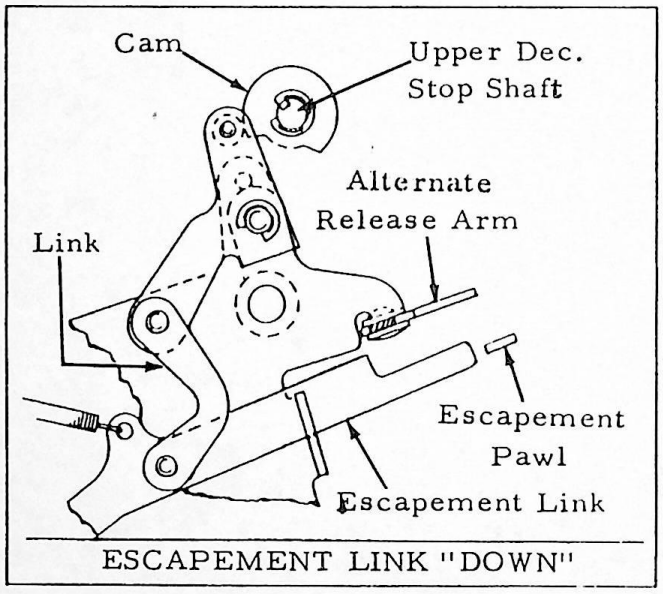


With a total of less than three decimal places set, the escapement link is in the up position and, as it is pushed to the rear, its rearward end engages the alternate release arm....The alternate release arm tries to push the lower decimal stop shaft to the left but the left end of this stop shaft is against the hold-up bell crank and the bell crank is against the hold-up roller arm. The roller of this roller arm is riding on the outside diameter of the carriage return cam hub. This causes a momentary yielding of the escapement link (loading its spring) until the main cam shaft is almost to hold-up position. At this point the notch in the hub of the carriage return cam aligns with the roller of the roller arm and the roller is pushed into the notch by the loaded escapement link spring. As the roller arm pivots, a stud on it lifts the hold-up latch out of the path of the main cam shaft clutch pawl...and the machine cycle continues. Note: As the cycle continues, the roller arm is cammed out of the notch in the cam hub. This pushes the decimal shafts to the right and again loads the escapement link spring...until the #5 program slide is restored to the right near the end of the cycle.

NOTE: Pushing the decimal stop shafts to the right moves the set-up carriage into proper lateral alignment with the racks. Only if 2 or more decimals are used. With 2 or less decimals, the escapement pawl holds the set up carr in alignment.

With a total of three or more decimals set, a cam on the right end of the upper decimal stop shaft holds its cam follower pivoted. A link on the cam follower connects to the escapement link... holding the escapement link in its down position. In this position the escapement link is out of alignment with the alternate release arm and in alignment with the escapement pawl for the set-up carriage.



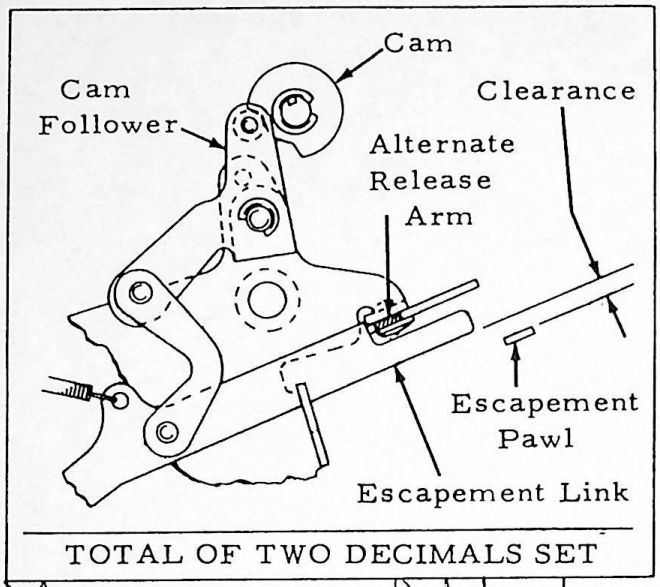


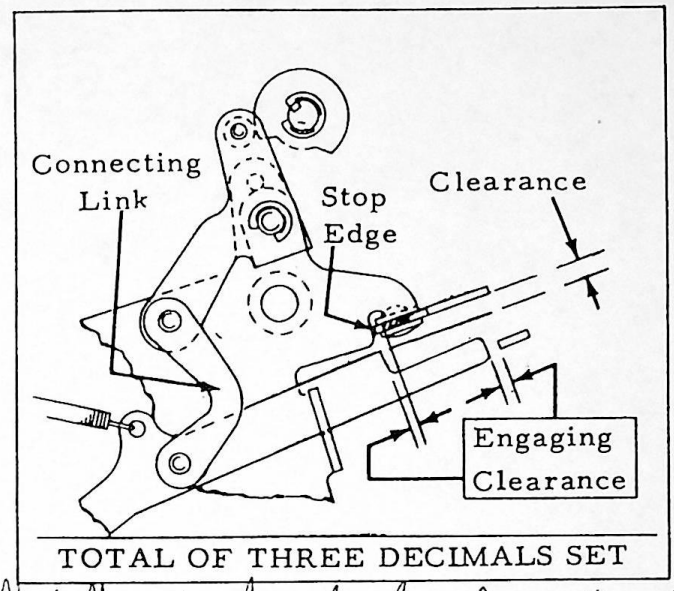
ESCAPEMENT LINK "DOWN"

With the escapement link in its down position it engages the escapement pawl as it is pushed to the rear by the escapement program slide (#5). This pivots the pawl out of engagement with the escapement ratchet gear... permitting the set-up carriage to escape to the left until the upward lug of the decimal carriage contacts the appropriate stop step on the upper decimal stop shaft. This contact moves the stop shafts to the left enough to push the roller of the hold-up roller arm into the notch of the cam hub and release the hold-up latch.

NOTE: On repeat and squaring functions the set-up carriage remains in its escaped position as subsequent machine cycles occur. Under certain load conditions the long spring for the set-up carriage may not be strong enough to trip the hold-up latch. An adjustable auxiliary spring is provided to insure proper hold-up latch tripping .... This spring is connected between the left frame of the decimal unit and a stud on the bracket that ties the decimal stop shafts together. Its adjustment is covered in the "Hold-up" sequence adjustment that follows.

Adjustment of Escapement Link Mechanism





If link is shortened, check to make sure that there is adequate release of escapement pawl & alternate release arm.

1. Adjust release link positioning cam.... With decimal knobs set at 1-1, roller of cam follower should position fully in upper radius of cam notch. With decimal knobs set at 1-2, roller of cam follower should position on outer radius of cam.... To adjust, loosen set screw in cam hub and position cam as required.

2. Check alignment of escapement link.... With decimal knobs set at 1-1, the escapement link should be aligned to engage the alternate release arm ...and have clearance to pass above the escapement pawl.

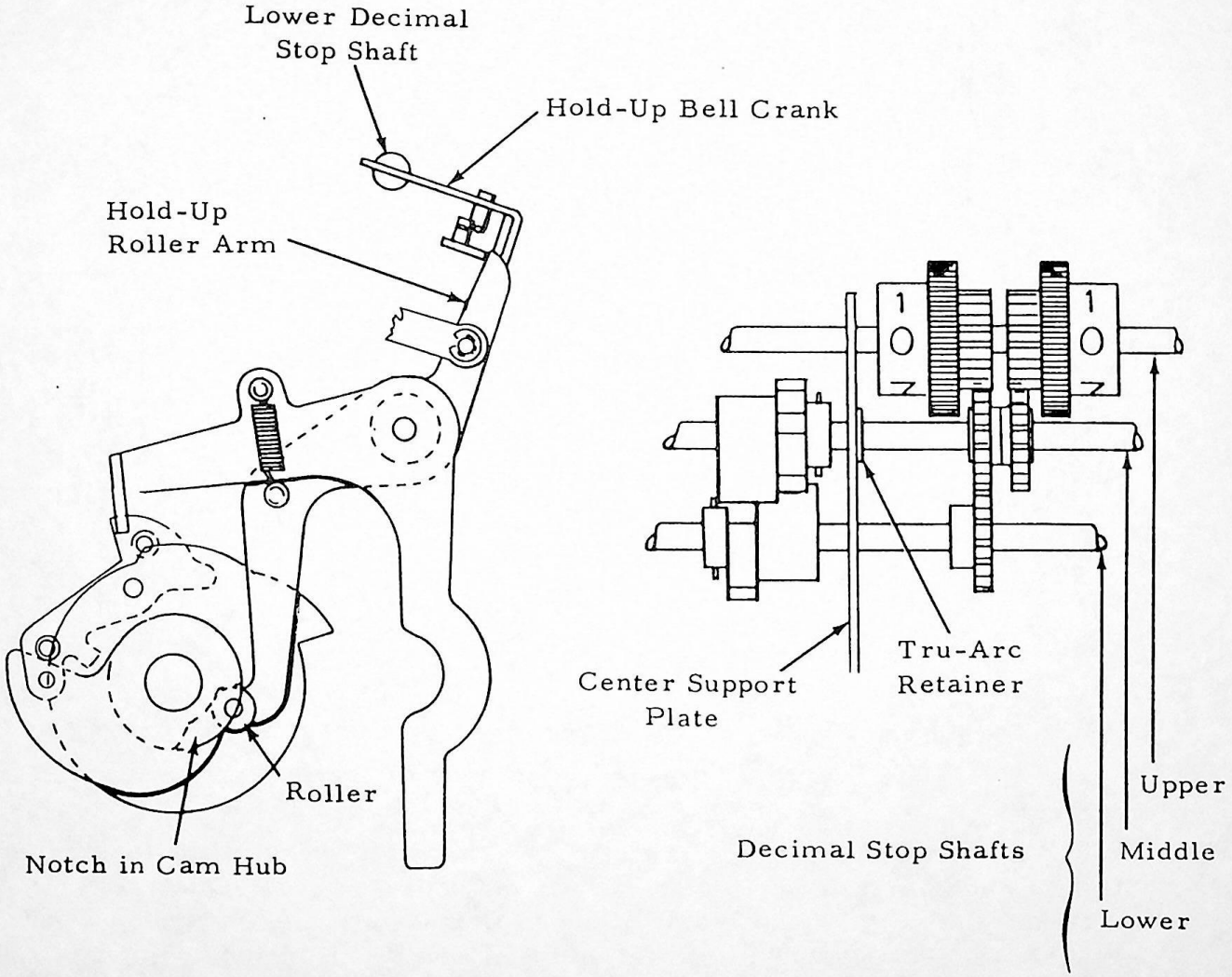
   With decimal knobs set at 1-2, the escapement link should be aligned to engage the escapement pawl and have clearance to pass under the alternate release arm.... Form connecting link to cam follower if required.

3. Check engaging clearance....
   In neutral position the escapement link should have vertical engaging clearance with alternate release arm and escapement pawl so that it can move up and down freely.... Form link to lengthen or shorten as required.... Check that escapement pawl is moved beyond point where it releases ratchet gear.
   NOTE: In checking for vertical engaging clearance of alternate release arm on earlier machines, hold the arm pivoted forward against stop edge of bracket. Later machines will contain a revised alternate release arm which does not limit against the stop edge of bracket. (Bracket will be cut back at this point). The rear operating tip of the revised release arm will be "trapped" between the gear and pulley on the right end of the lower decimal stop shaft. The pulley should be positioned laterally for minimum end play of the release arm... without cramping.

Adjustment of Hold-Up Release Mechanism

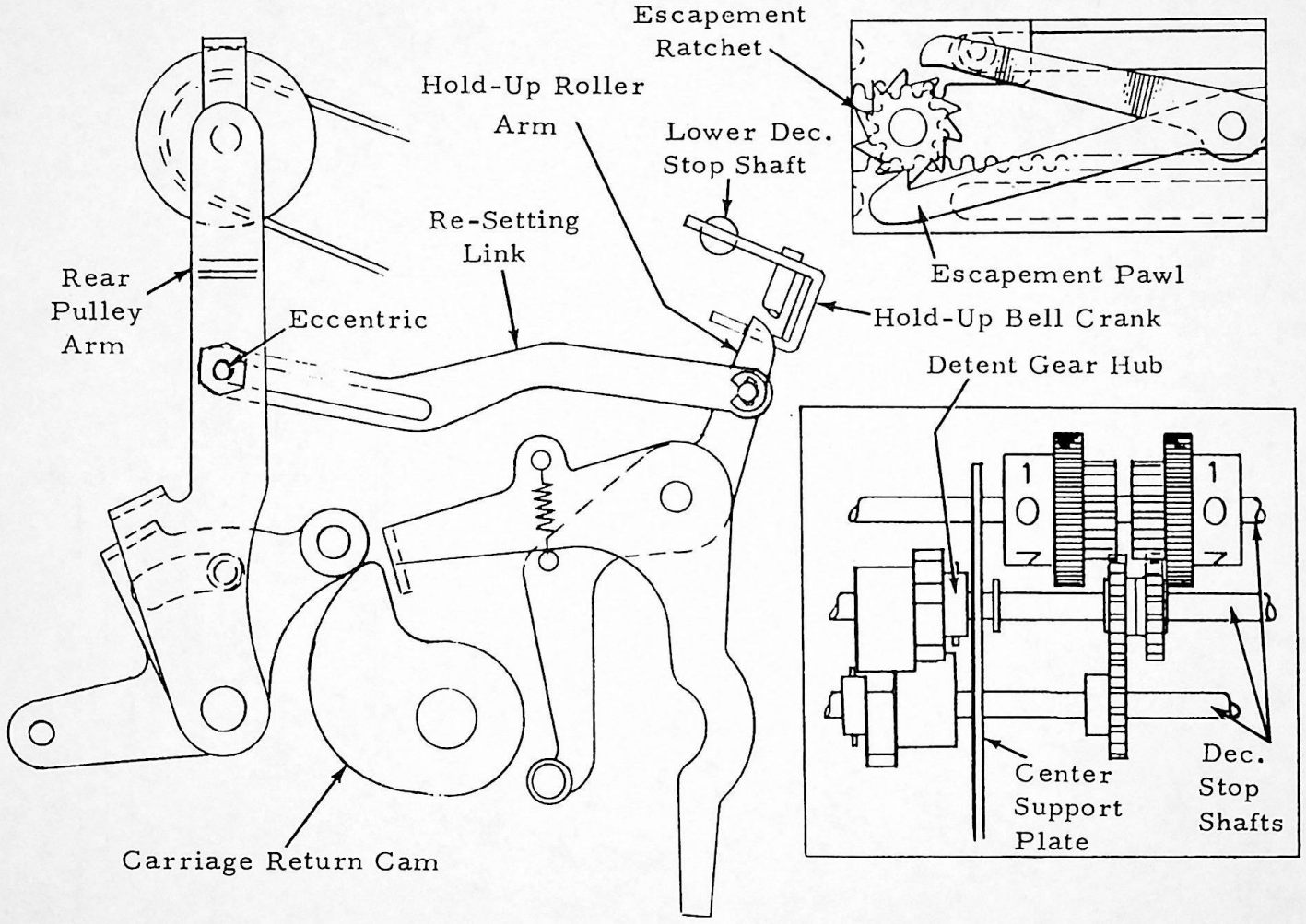
1. Re-check set-up carriage return cable adjustment (Page IV-C-20).

2. Adjust Hold-Up Bell Crank....
Depress plus key and cycle machine with a hand crank until roller of hold-up roller arm moves fully into notch in hub of carriage return cam. At this point the decimal stop shafts should be positioned to the left so that the tru-arc retainer on the middle stop shaft is against the center support plate of the decimal unit and the hold-up bell crank should have no play between the hold-up roller arm and the left end of the lower decimal stop shaft....Form hold-up bell crank as required.



Continue cycling and check lateral alignment of set-up carriage gears with racks after making the above adjustment.
NOTE: Racks will favor right side of set-up gears...however, if full width of rack teeth meshes with set-up gear the condition is acceptable.

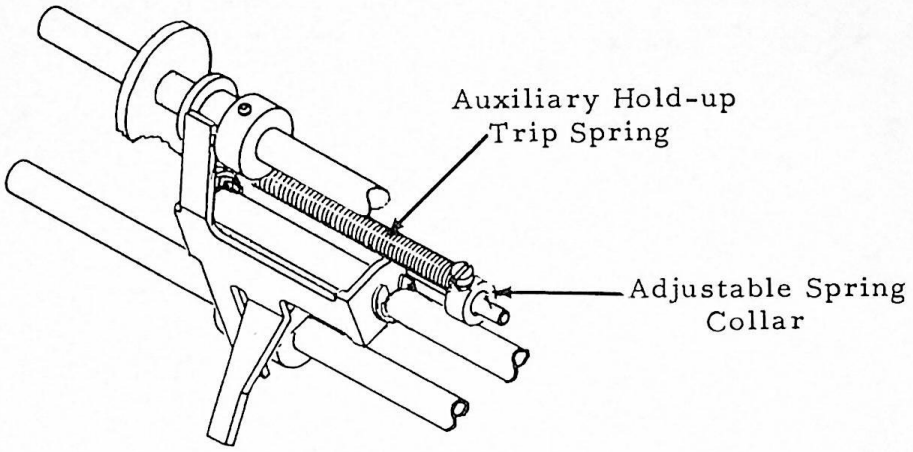
3. Adjust re-setting link eccentric....
NOTE: This mechanism re-latches the set-up carriage escapement pawl...holding the set-up carriage aligned with the proper column... on squaring operations. As the rear pulley arm is driven rearward by the carriage return cam, the resetting link pulls the hold-up roller arm rearward...pivoting the hold-up bell crank which pushes the decimal stop shafts to the right. The decimal stop shaft in use moves the decimal carriage...which moves the set-up carriage...which moves the front positioning slide...which turns the escapement ratchet just enough to re-latch the escapement pawl.



To adjust, start with high side of eccentric forward (to provide the least amount of movement). Set decimal knobs at 5-5 and depress square and × keys. Cycle machine rapidly with hand crank. Check for re-latching of escapement pawl (it probably won't re-latch with eccentric in this position). Push set-up carriage "home" and repeat the square × operation...turning the eccentric slightly for more movement each time...until the pawl just re-latches on rapid hand crank operation. Check re-latching under power.

After making this adjustment, check to be sure that nylon detent gear on middle decimal stop shaft does not cramp against center support plate of the decimal unit when roller of cam follower is on high point of carriage return cam.

4. Adjust auxiliary hold-up trip spring....Set decimal knobs at 5-7...depress decimal key and enter five digits. Depress multiplication (=) key....The hold-up latch should be tripped thru the action of the decimal stop shafts moving to the left. If hold-up latch does not trip, move adjustable spring collar slightly to the right and repeat the operation...continuing to do this until hold-up latch does trip.



With same decimal setting, enter one digit and depress plus key while holding set-up carriage to the right....The hold-up latch should not be tripped by the action of the auxiliary spring alone. If it does trip, move adjustable collar to the left.

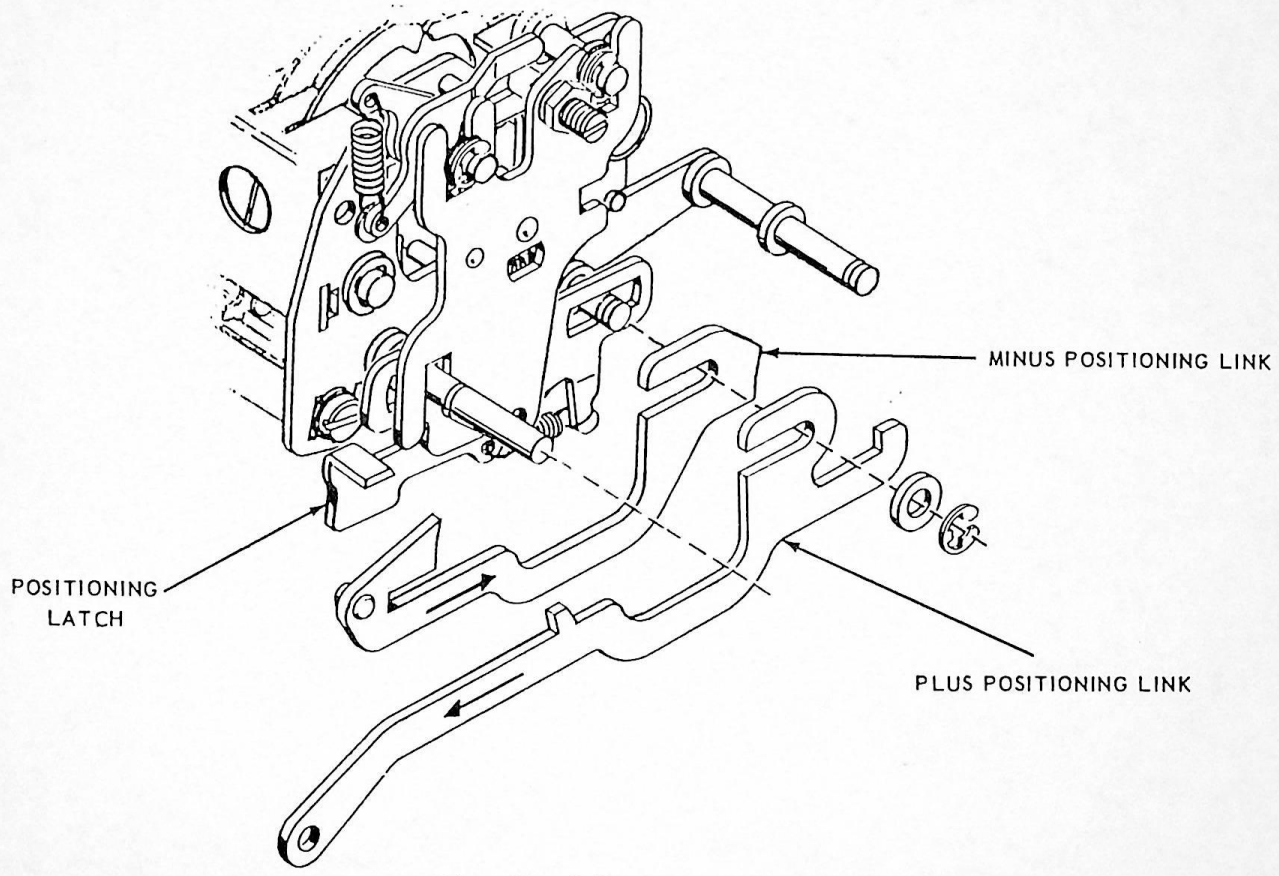
The adjustment should be balanced between the two conditions mentioned.

Minus Positioning Link

The normal position of the minus link is forward and it moves rearward as the plus positioning link moves forward.

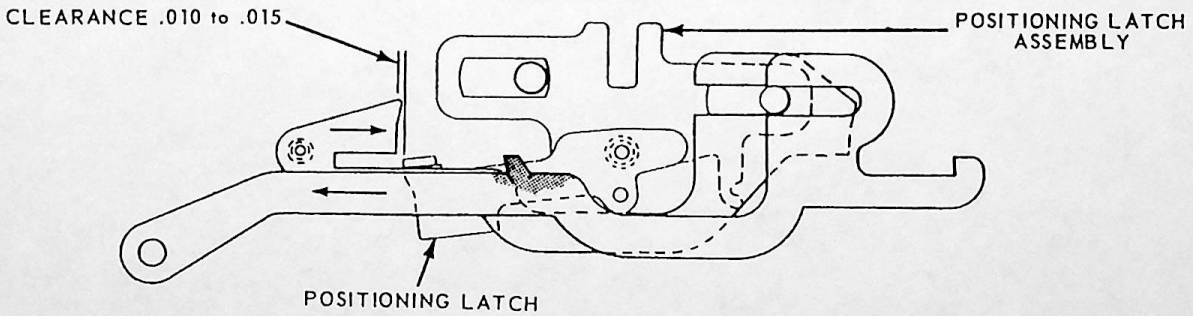
The slot in the minus positioning link prevents the link from contacting the latch and does not operate the latch as the minus link moves rearward during a plus operation.

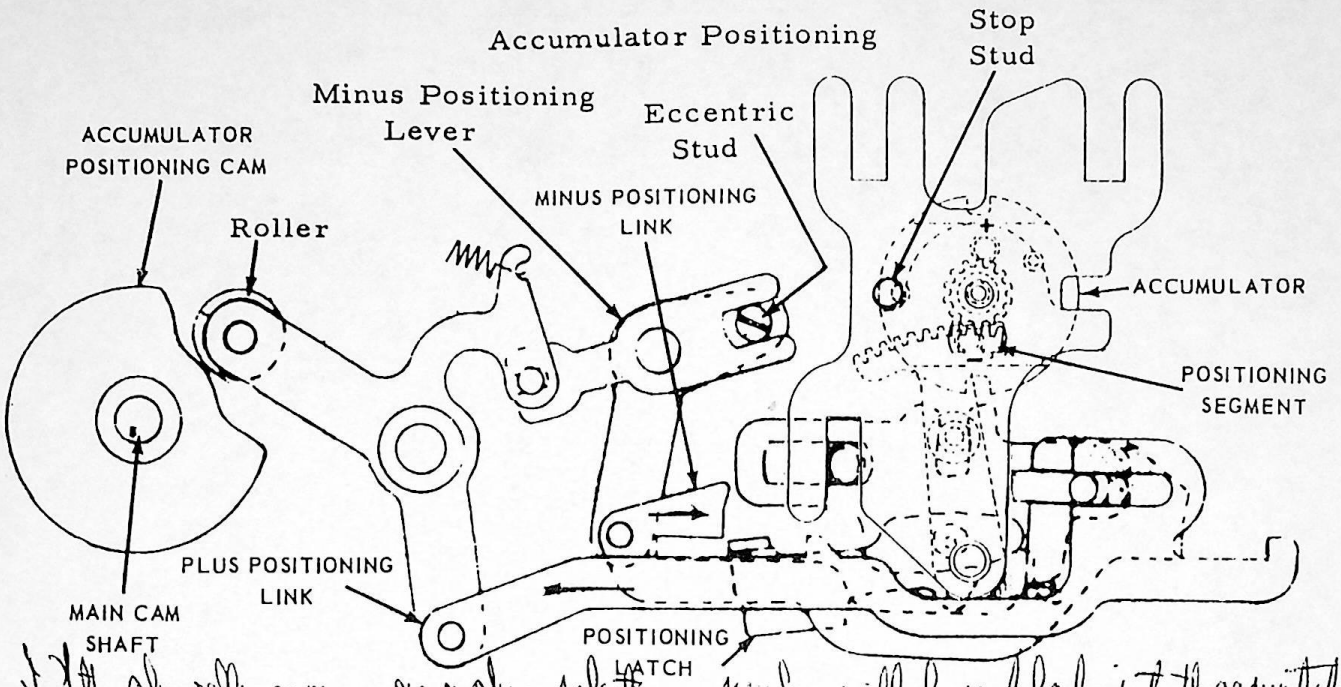
On a minus operation the positioning latch is raised into engagement with the link and operates the latch assembly to the rear, rotating the accumulator to minus, then the link returns to the forward position.



Plus Positioning Link

The normal position of the link is to the rear, the link moves forward to position the accumulator latch assembly forward, rotating the accumulator to the plus position, and then the link moves rearward to its normal position.

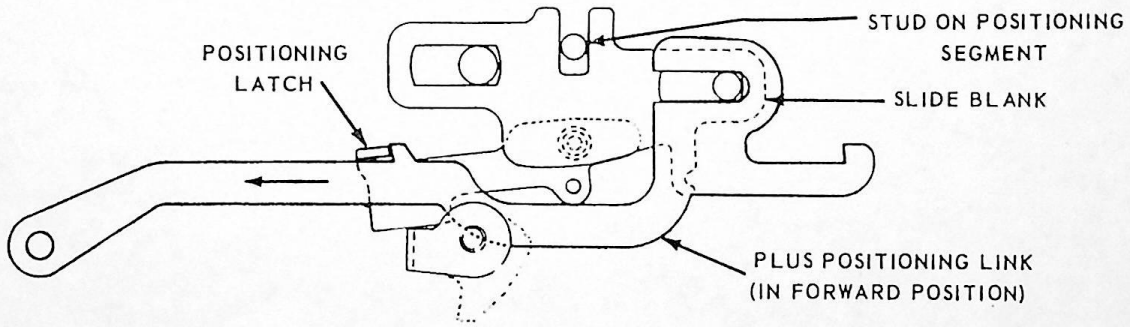




The plus and minus cam follower operates the accumulator to its plus or minus position. The plus positioning link moves forward as the minus positioning link moves rearward.

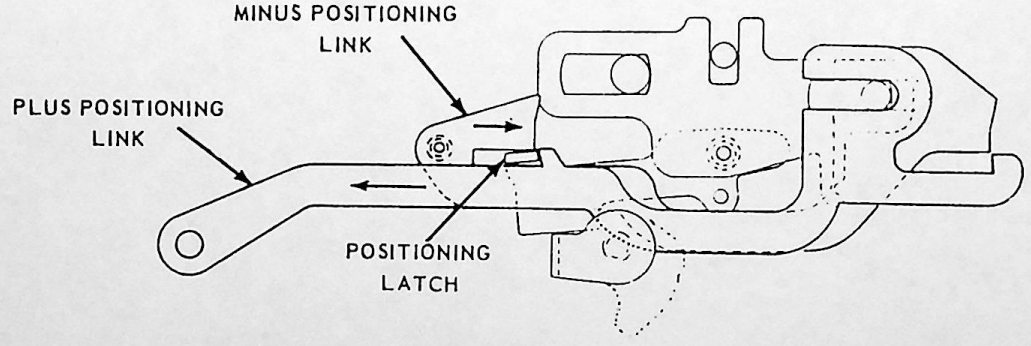
Adjustment: The accumulator must be positioned firmly (but without cramping) against stop stud when rotated to both plus and minus position....If adjustment of plus positioning is required, change cam follower roller (see roller chart on Page 20-4 of Parts Catalog)....The minus positioning is adjusted by means of the eccentric stud in the minus positioning lever.

Plus Positioning of the Accumulator

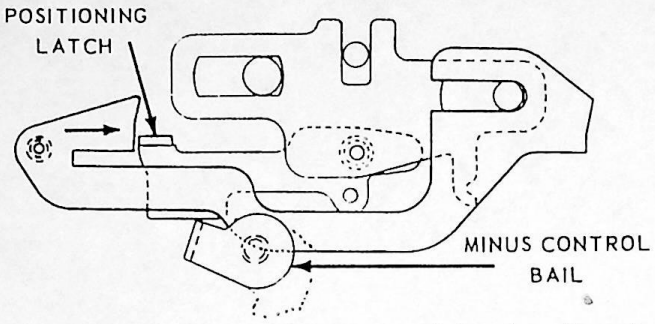


The accumulator will always return to the plus position if the positioning latch is in its down position.

NOTE: As the minus positioning link moved rearward and the plus positioning link moved forward, the offset of the latch enters the slot in the minus positioning link.

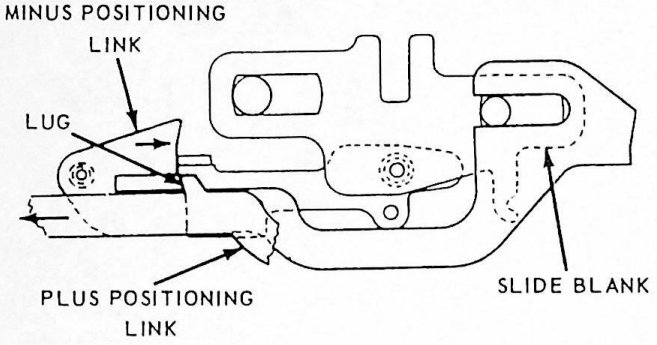


Positioning Latch in Raised Position

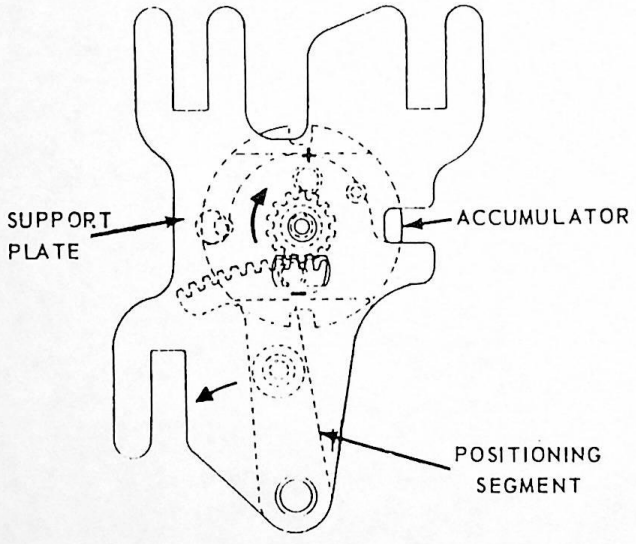


The positioning latch when raised by the minus control bail is in the path of the minus positioning link, and out of the path of the lug on the plus positioning link.

Positioning the Accumulator in Minus

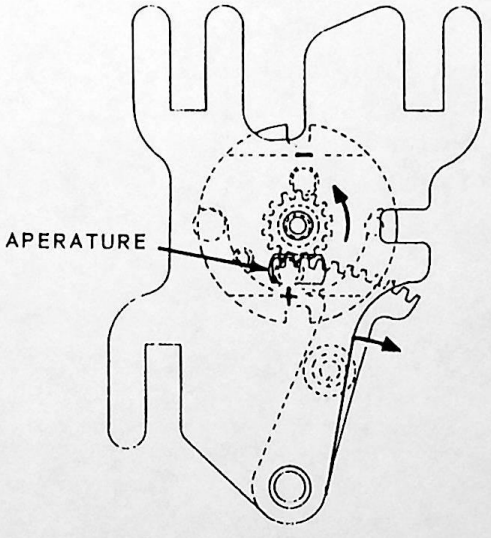


The minus positioning link as it moves rearward contacts the positioning latch and positions the slide blank rearward. The accumulator rotates counter-clockwise as the positioning segment moves rearward and the minus accumulator gears are in position to mesh with the racks.
NOTE: The lug on the plus positioning link passes under the lug on the positioning latch.



Positioning Segment-Plus Position

The accumulator positioning segment in moving to its forward position, rotated the accumulator clockwise.
Note the number of teeth visable in the aperture of the support plate.



Positioning Segment-Minus Position

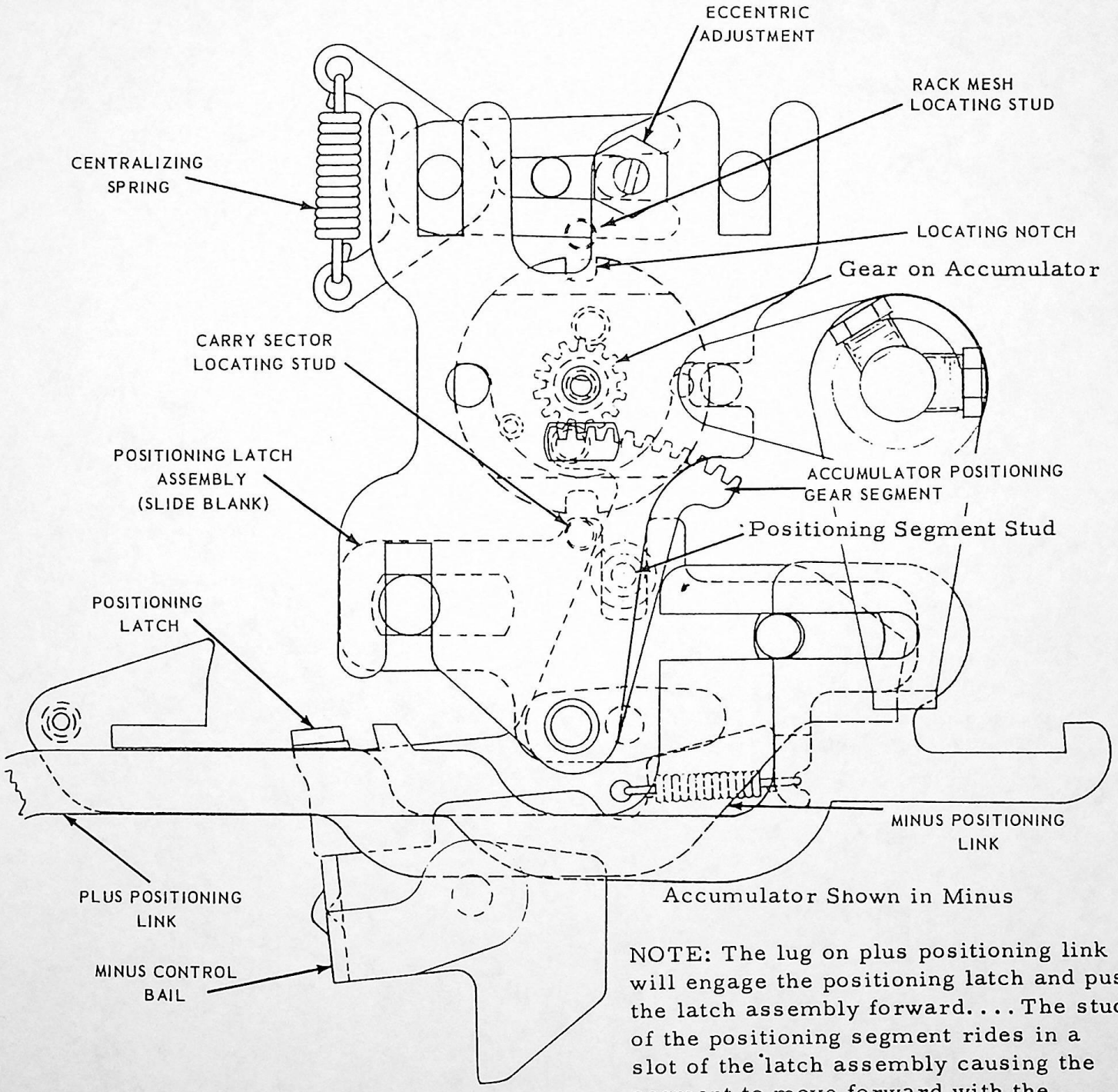
The accumulator positioning segment in moving to its rearward position rotated the accumulator counter-clockwise.
Note the number of teeth visable in the aperture of the positioning plate.

Accumulator Positioning Latch Assembly

The offset of the latch in its normal or down position engages the lug on the plus positioning link, and the slot in the minus positioning link is opposite the offset.

The lower part of the latch is resting on the minus control bail.

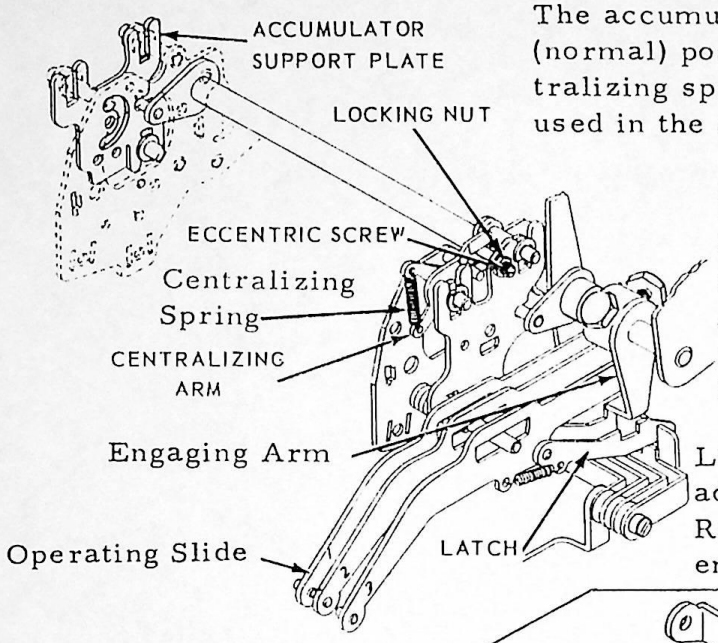
The lower part of the positioning latch has a slight clearance with the minus positioning link.



Accumulator Shown in Minus

NOTE: The lug on plus positioning link will engage the positioning latch and push the latch assembly forward.... The stud of the positioning segment rides in a slot of the latch assembly causing the segment to move forward with the latch assembly. The segment turns the gear on the end of the accumulator which rotates the accumulator 180° clockwise.

Accumulator Support Plates



The accumulator support plates are held in the central (normal) position by the centralizing arms and centralizing spring. NOTE: Operating slides #2 and #3 are used in the adding machine function.

Accumulator Centralizing Adjustment

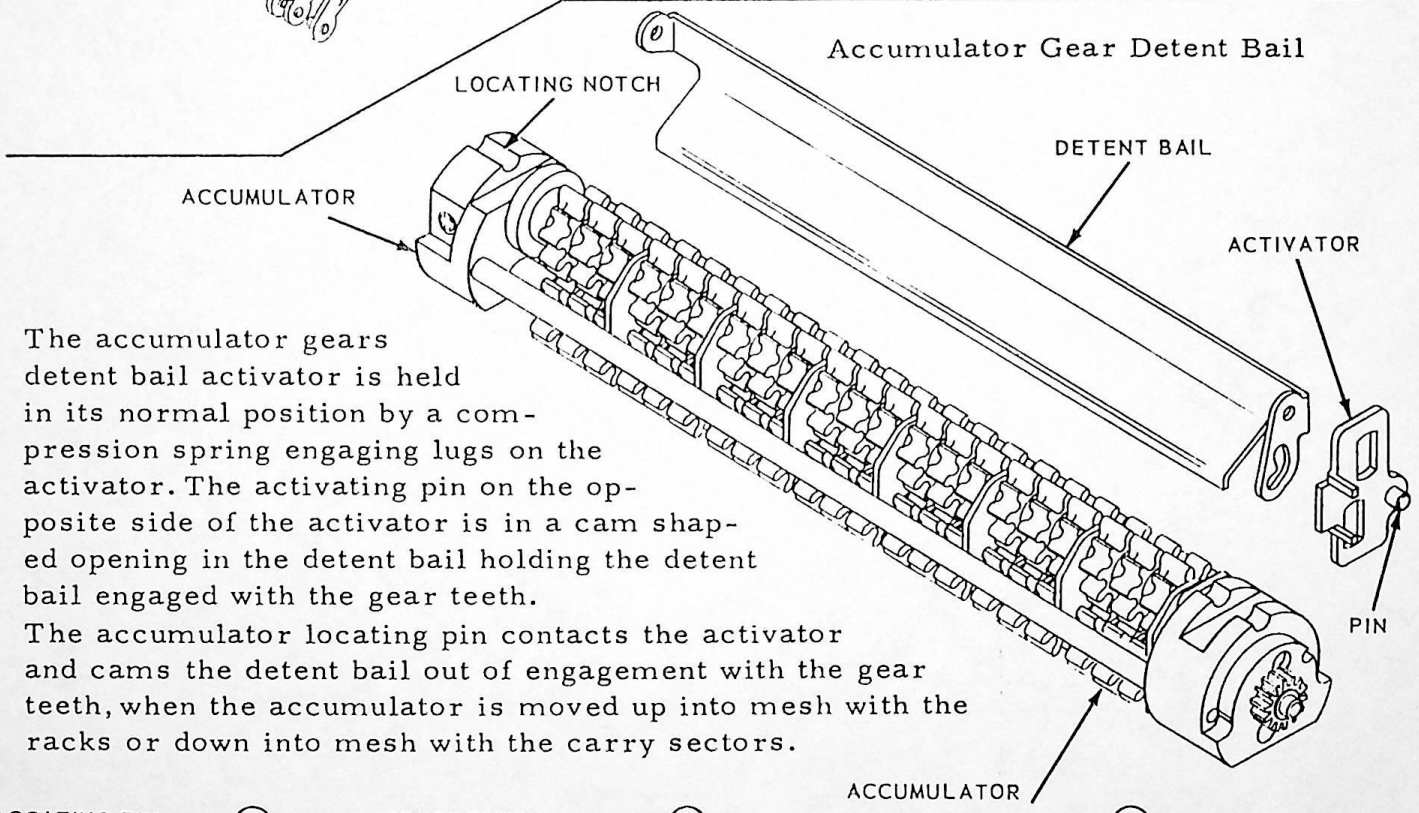
Loosen the locking nut, adjust accumulator to the central position by the eccentric screw.

After adjusting check that the accumulator rotates freely in either direction. Retighten locking nut.

Accumulator Engaging Arm Adjustment

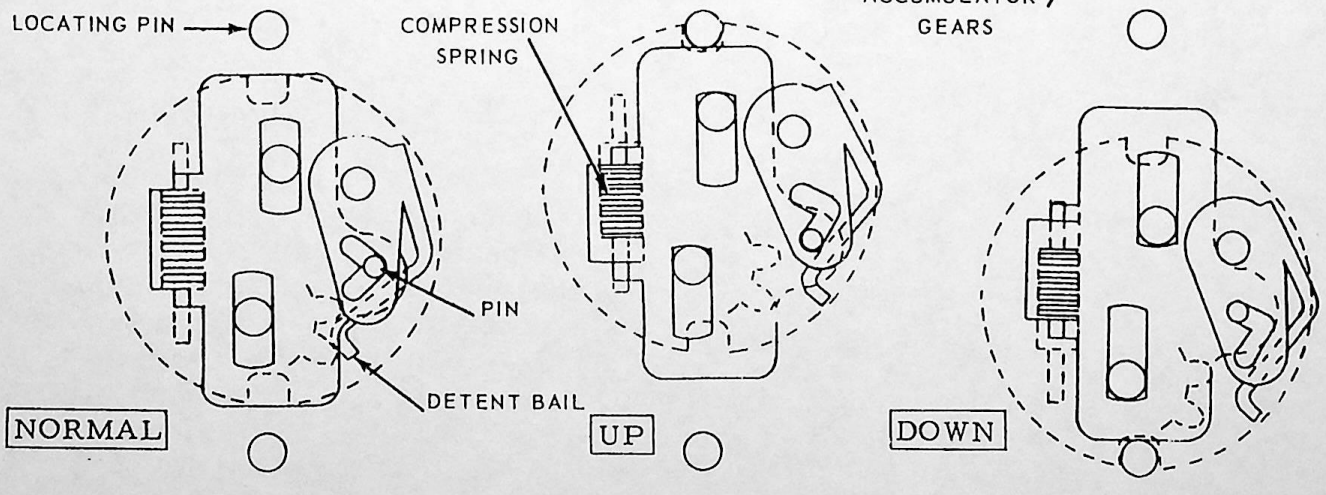
Loosen the locking screws - raise latch and adjust engaging arm to rear of notch in latch. Retighten locking screws... check that latches engage freely without "hanging-up".

Accumulator Gear Detent Bail

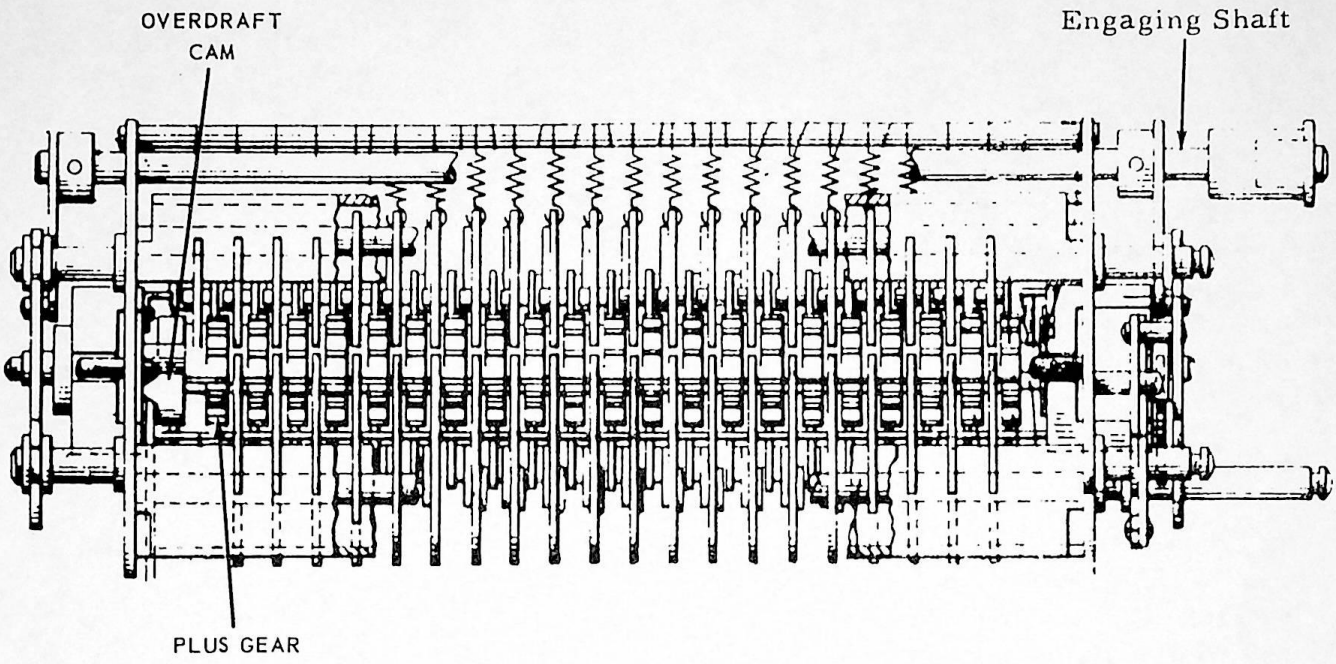


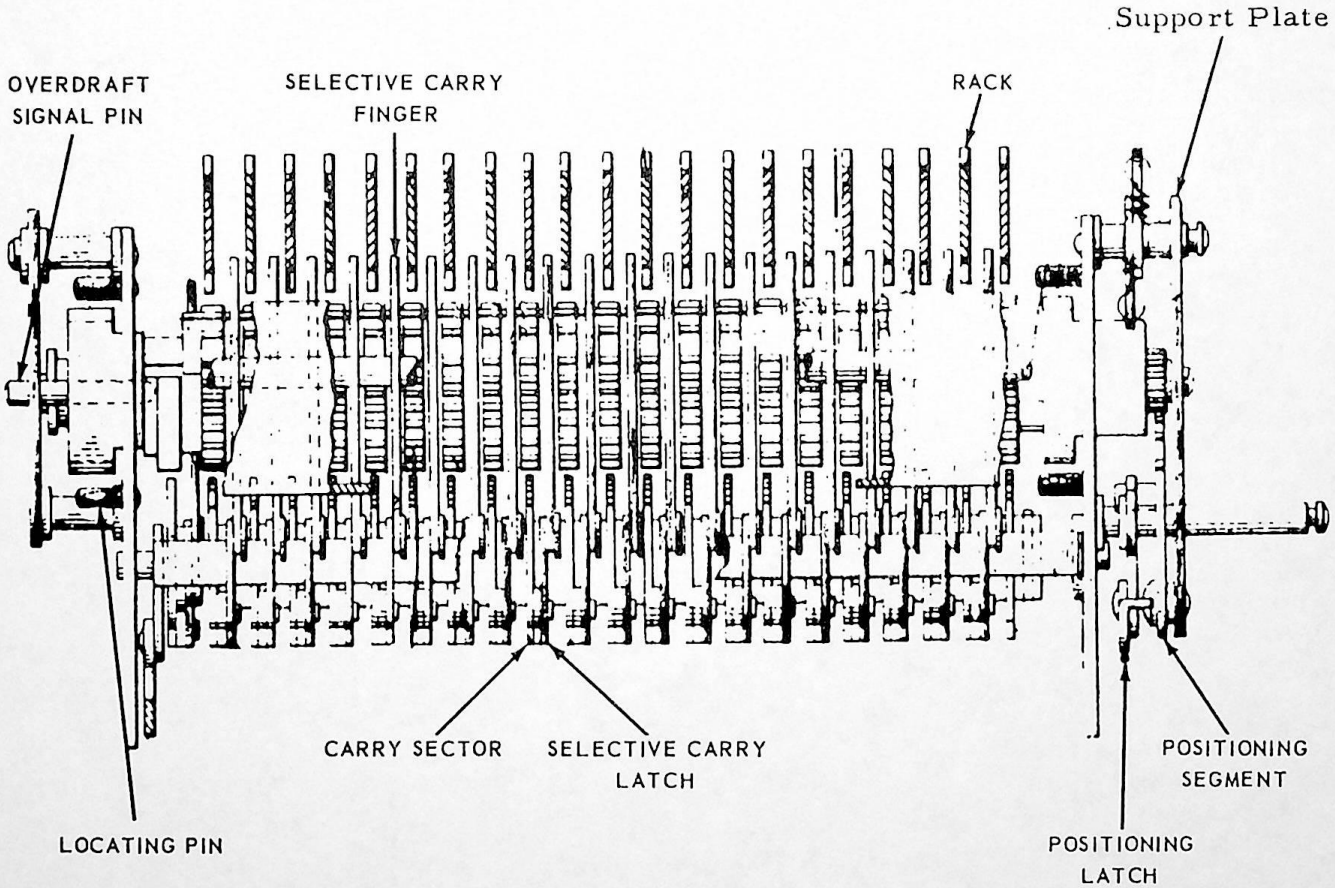
The accumulator gears detent bail activator is held in its normal position by a compression spring engaging lugs on the activator. The activating pin on the opposite side of the activator is in a cam shaped opening in the detent bail holding the detent bail engaged with the gear teeth.

The accumulator locating pin contacts the activator and cams the detent bail out of engagement with the gear teeth, when the accumulator is moved up into mesh with the racks or down into mesh with the carry sectors.



Top View of Accumulator Assembly





Rear View

OPERATING SLIDES #1, #2, and #3

The #1 and #3 slides operate forward, rearward and then return to the middle or neutral position (by the main cam shaft). Slide #2 operates forward only and then returns to neutral.

#1 Operating Slide

The inside or #1 operating slide, moves the register gears into mesh with the racks by the forward latch for a dividend entry, during the operating slide forward movement. The rear latch operates the multiplier gears into mesh with the racks on the forward movement for a multiplier gear set-up. The rear latch operates the trip bail for the sensing bails, on the operating slide rear movement.

#2 Operating Slide

The #2 operating slide moves the set-up carriage into mesh with the racks, on the forward movement by a drive arm. The rear latch operates the multiplier gears into mesh with the racks, for a quotient total, on the control slide forward movement. The inside forward latch operates the register gears into mesh with the racks, for a multiplication total, on the forward movement of the control slide. The outside forward latch operates the accumulator gears into mesh with the racks, for an accumulation total, on the forward movement of the control slide. This slide moves forward and then to the middle or neutral position; it does not move rearward.

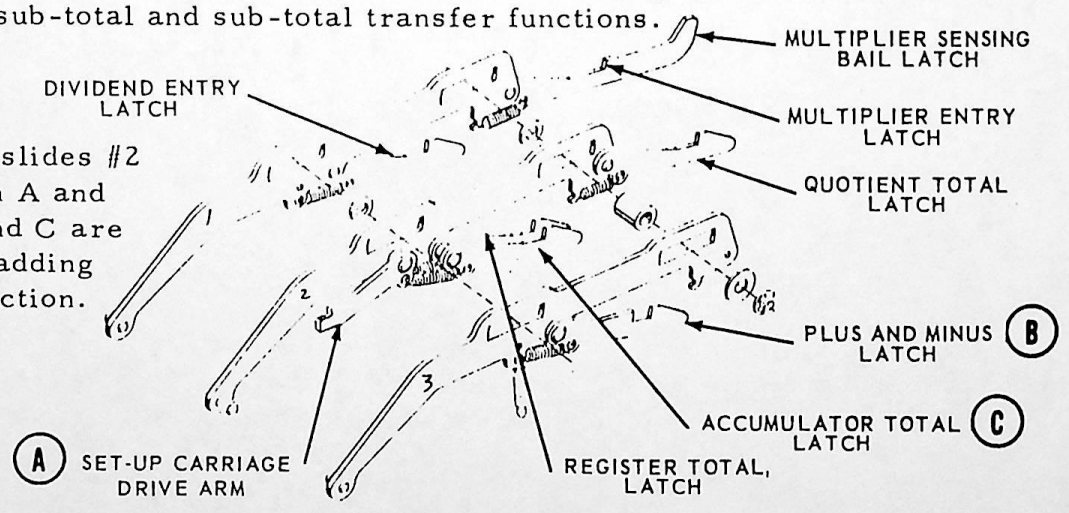
#3 Operating Slide

The outside or #3 operating slide moves the accumulator gears into mesh with the racks, for plus and minus accumulation, on the forward movement of the operating slide. The rearward movement of the operating slide moves the accumulator gears down into mesh with the carry segments for the carry, and the control slide returns to the middle or neutral position.

Note

Operating slide #2 will remain longer in its forward position for repeat, squaring, sub-total and sub-total transfer functions.

NOTE: The slides #2 and #3, arm A and latches B and C are used in the adding machine function.

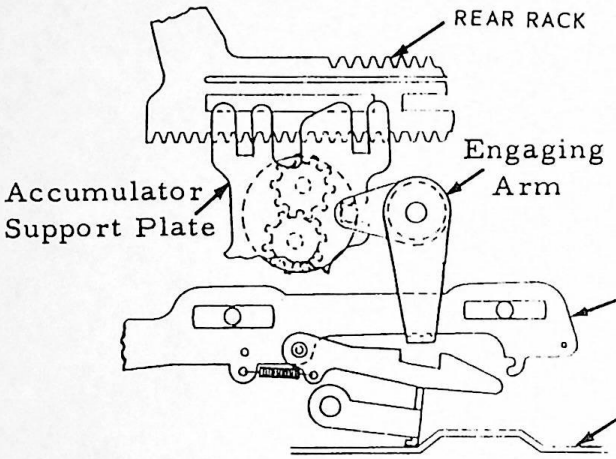


Accumulator Plus and Minus Program Slide (#2)

When the accumulator plus and minus program slide (#2) is moved to the left on the first 24° of the machine cycle it pivots a bell crank which pulls the accumulator plus and minus control slide forward. The forward movement of the accumulator plus and minus control slide raises the accumulator plus and minus control bail. The raising of the accumulator plus and minus control bail raises the plus and minus latch on operating slide #3 into engagement with the accumulator engaging arm.

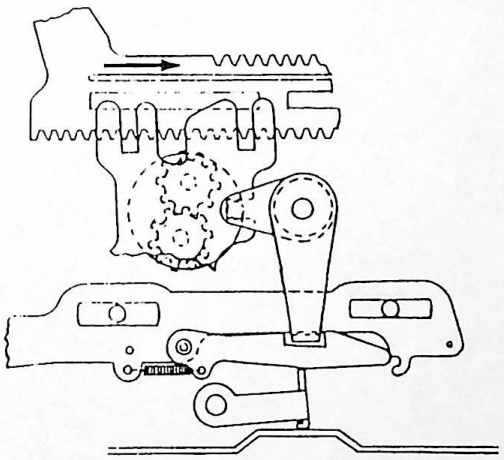
The following outline covers the accumulator engaging sequence:

Normal Position



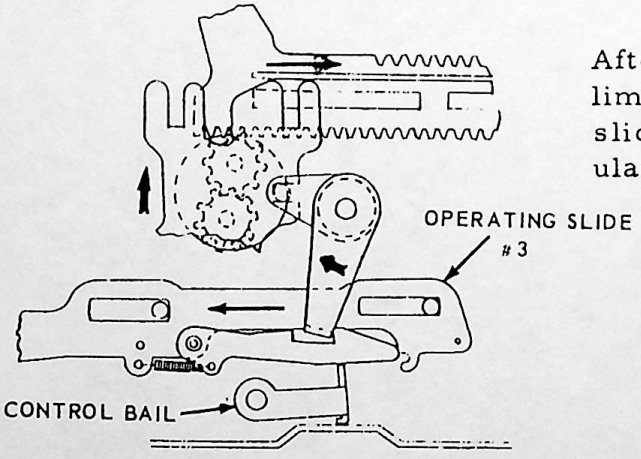
The rear rack is in its forward position. The accumulator and operating slide #3 in the middle position, and the plus and minus control slide in it's rearward position.

Programming



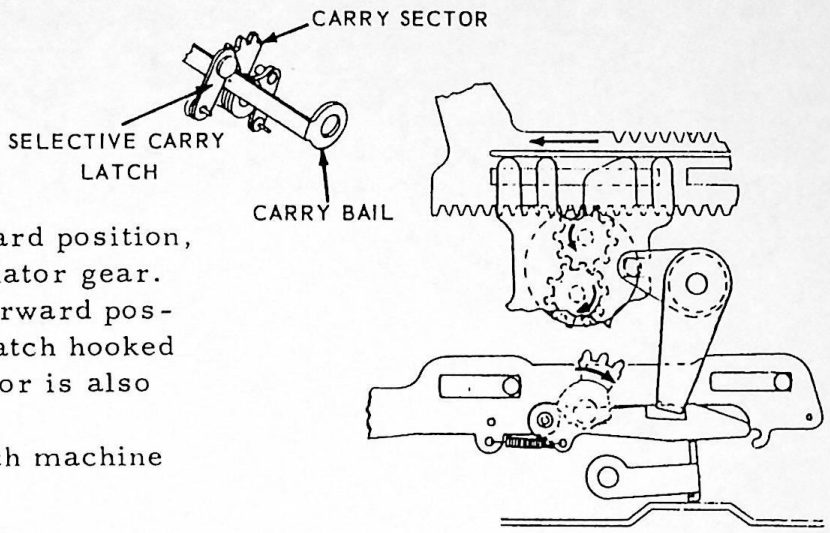
The plus and minus control slide moves forward and raises the plus and minus control bail and the latch engages the accumulator engaging arm.

Meshing the Accumulator Gear With the Rear Rack



After the rear rack has moved to its rearward limit and in the aligned position, the operating slide # 3 moves forward positioning the accumulator up into mesh with the rear racks.

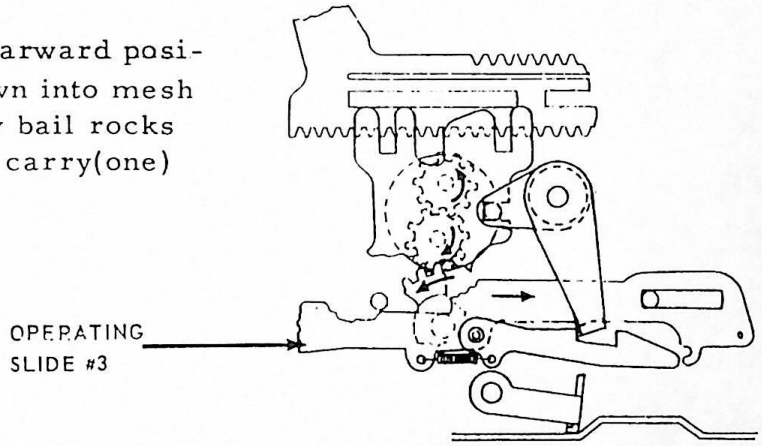
Setting the Selective Carry



The rear rack returns to it's forward position, rolling the amount into the accumulator gear. The carry bail is rocked to the rearward position, and when a selective carry latch hooked over the carry bail, the carry sector is also rocked rearward.
NOTE: The carry bail rocks on each machine cycle.

Entering the Carry to the Accumulator Gear

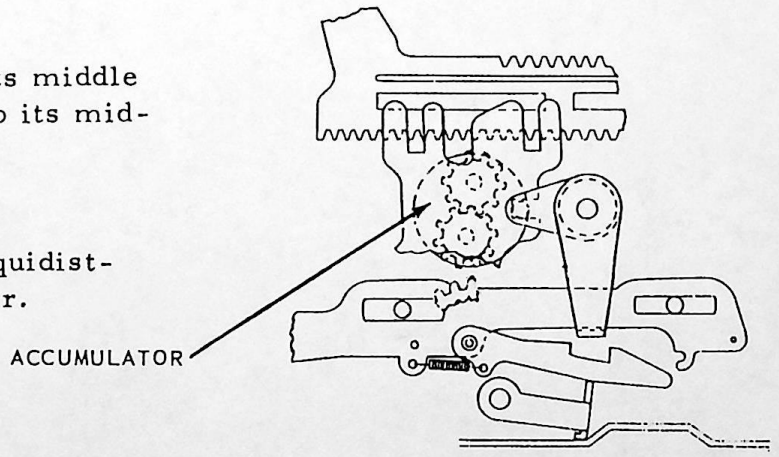
The operating slide #3 moves rearward positioning the accumulator gear down into mesh with the carry sector. The carry bail rocks back to normal while rolling the carry(one) into the accumulator gear.



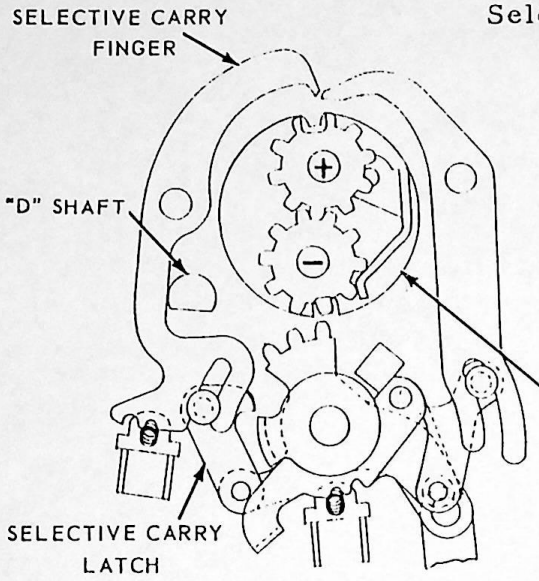
Returning the Accumulator to its Middle Position

The operating slide #3 moves to its middle position, the accumulator moves to its middle position.

NOTE: The accumulator is now equidistant from the rack and carry sector.



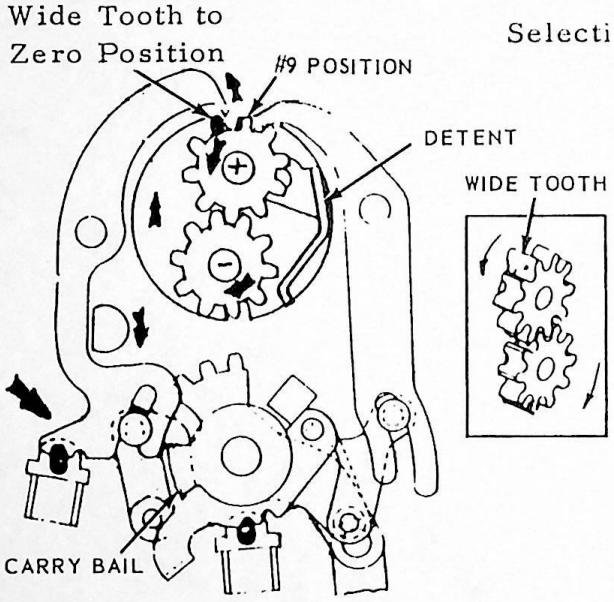
Selective Carry Mechanism



Normal Position

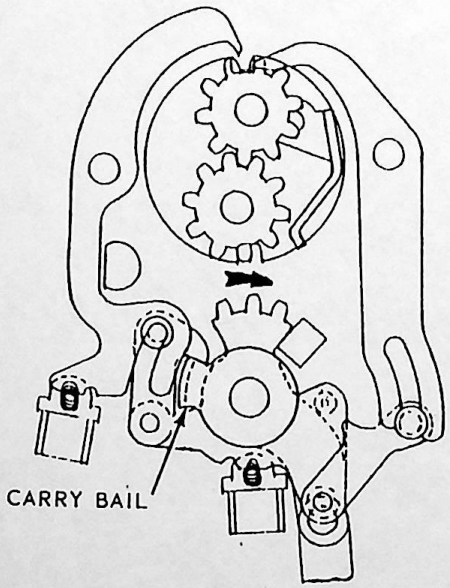
The selective carry finger is locked in the restored (normal) position by the "D" shaft. The selective carry latch is disengaged from the carry bail, the accumulator is in its middle position and the detent bail engaged with the minus accumulator gear teeth.

Selective Carry Setting



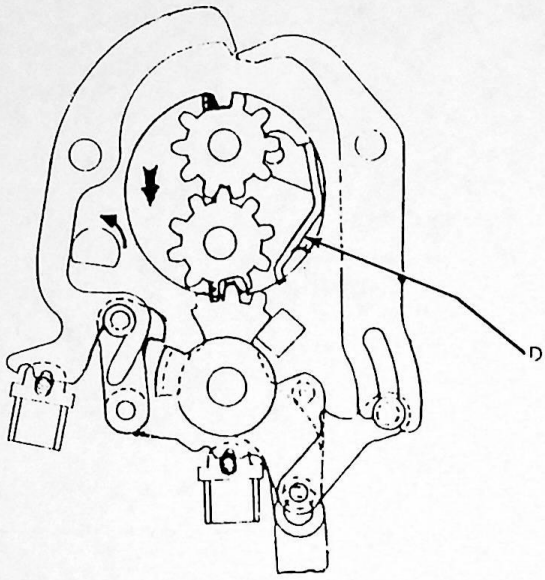
The "D" shaft rotated to its unlocked (carry setting) position. The detent bail disengaged from the accumulator gear teeth as the accumulator moved up into mesh with, and just before the racks start their forward movement. The wide tooth of the accumulator gear pivots the selective carry finger, and positions the selective carry latch over the carry bail when the wide tooth moves from the #9 to zero position of the accumulator gear as the rack returns to its forward (normal) position.

Carry Bail Rearward Movement



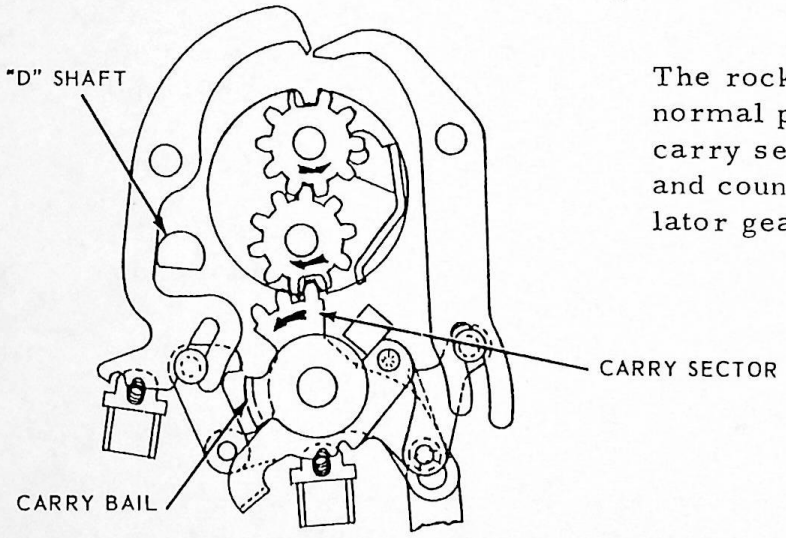
The carry bail positions the carry sectors to their carry positions before the accumulator moves down into mesh with the carry sectors.

Accumulator Gears in Down Position



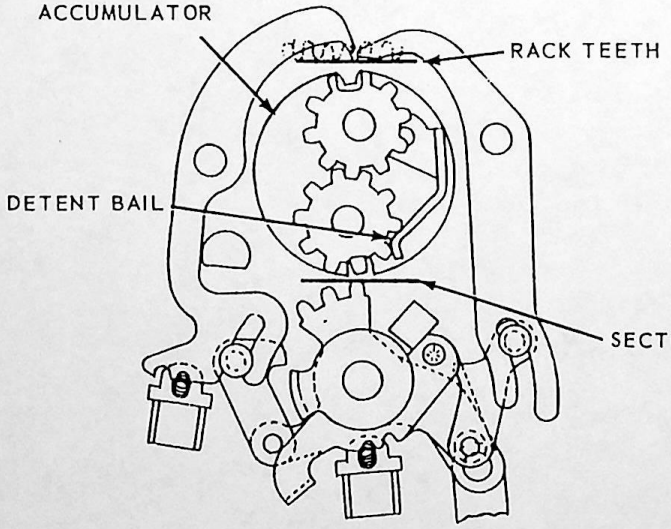
The accumulator moved from its up (rack mesh) position to its down (carry sector) mesh position.
NOTE: The detent bail also moves out of the gear teeth in this position.
The "D" shaft is rotated to the locked position. This re-sets the selective carry finger to its normal position.

Counting in the Carry One



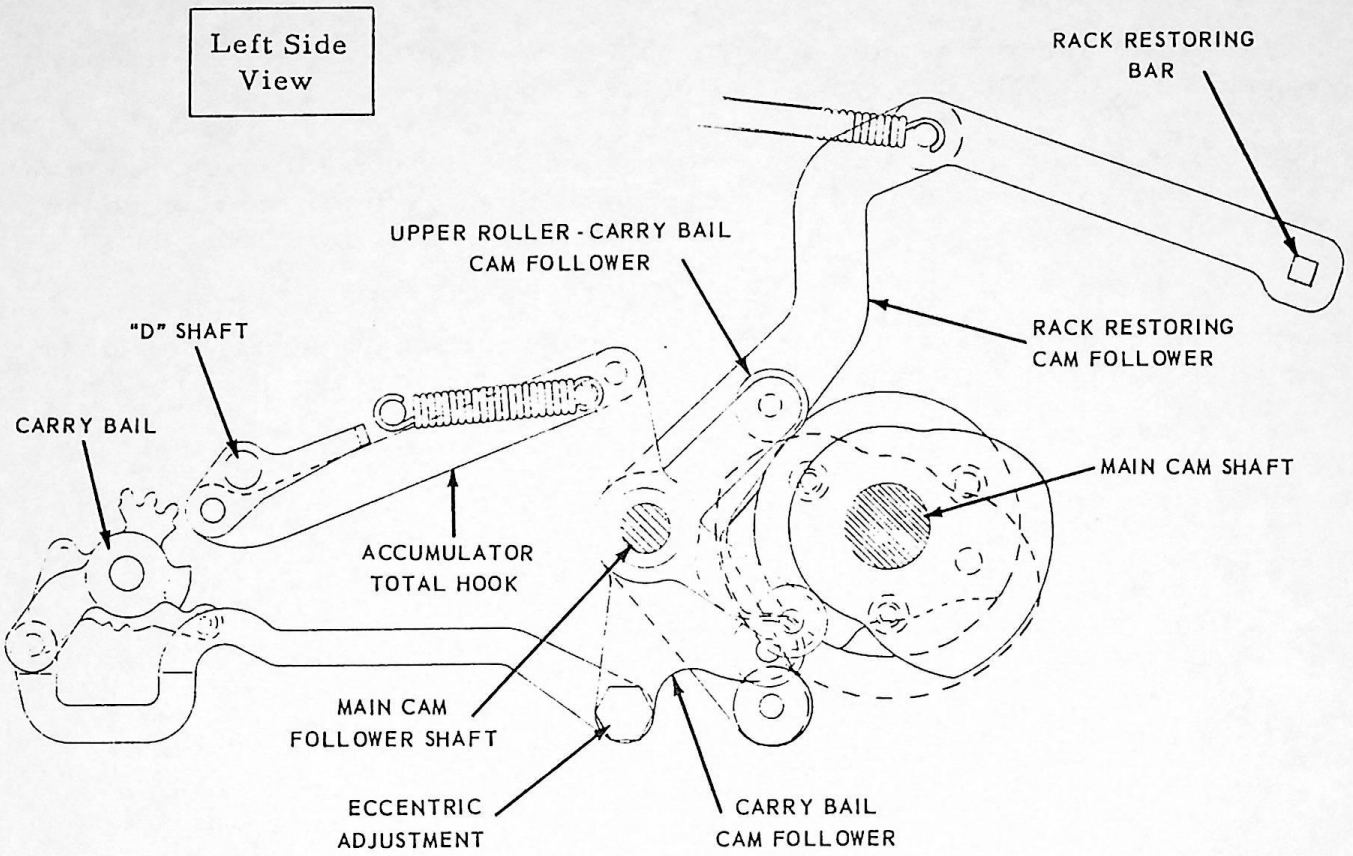
The rocking of the carry bail back to its normal position returns all the displaced carry sectors to their normal position and counts the carry ones into the accumulator gears.

Accumulator in Middle Position



After the carry sector was returned to its normal position, the accumulator moved out of mesh with the carry sector, and is now equidistant from rack mesh and carry sector mesh.
NOTE: The detent bail engaged with the teeth.

CARRY BAIL ADJUSTMENT



Enter a one in the numeral keyboard, depress the minus key and clear the minus accumulator gears by depressing the total key. The plus accumulator gears now contain all nines. Enter a one in the numeral keyboard, remove the motor cord and insert the hand crank.

Depress the plus bar and operate the hand crank until the printing hammers fire. Tip the machine up on its back and continue to operate the hand crank slowly until the printing rack is returned to its forward position. Check that the carry sectors have all been fully rocked to their carry position, and if not, adjust the carry bail.

To adjust carry bail with machine in neutral, insert Kit Tool #207 and turn eccentric until minimum clearance exists between carry bail and carry sectors. Check for full displacement of all carry sectors to carry position.

NOTE: The carry bail cam follower is one of the 4 double roller cam followers.

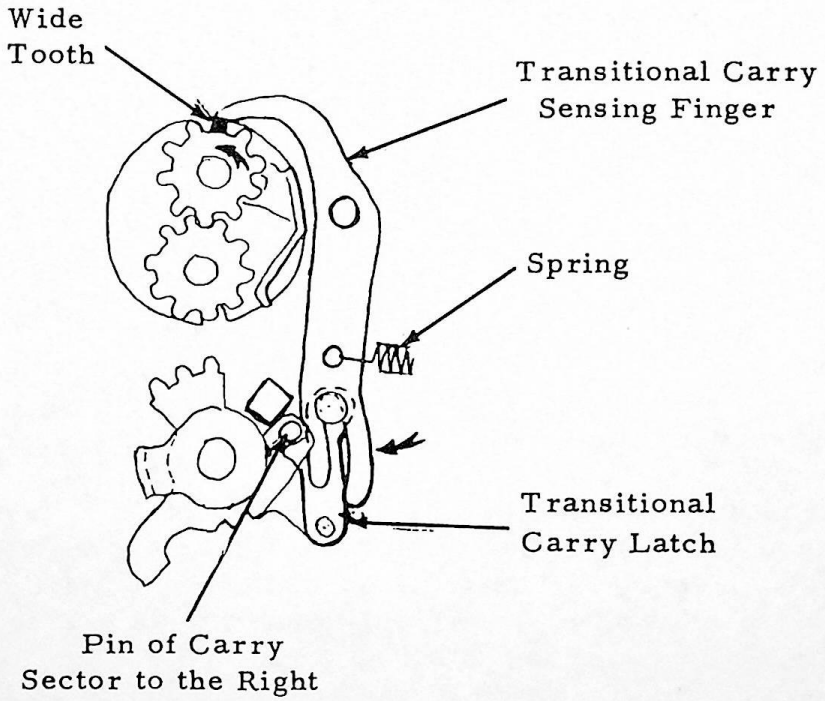
Transitional Carry Sensing Finger

The transitional carry sensing finger is held in its down (or normal) position by a spring and in the path of the wide tooth of the accumulator gear.

With the accumulator gears in mesh with the racks and a nine (9) registered in an accumulator gear the wide tooth of the gear will pivot the finger and position the transitional carry latch under the pin of the next carry sector to the right.

With the transitional carry latch under the pin, the rocking of the carry sector to the right (by the selective carry latch and carry bail), also rocks the carry sector to the left.

Note:
The transitional carry must be accompanied by a selective carry to the right.



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Supplement of 9/22/67

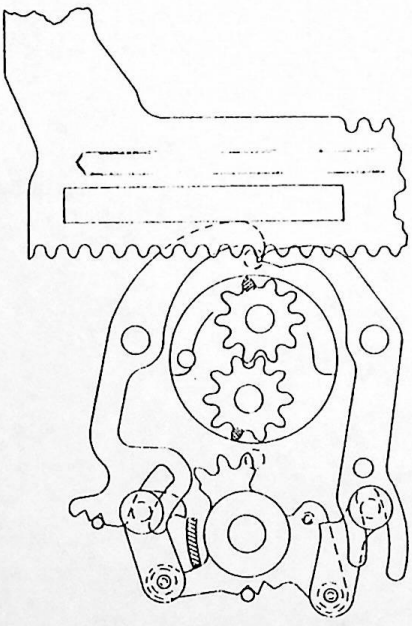
Please insert this supplement (pages IV-E-29 thru IV-E-32) in proper sequence in your copy of C.S.B. #P2-502.

Full Transitional and "End-around" Carry

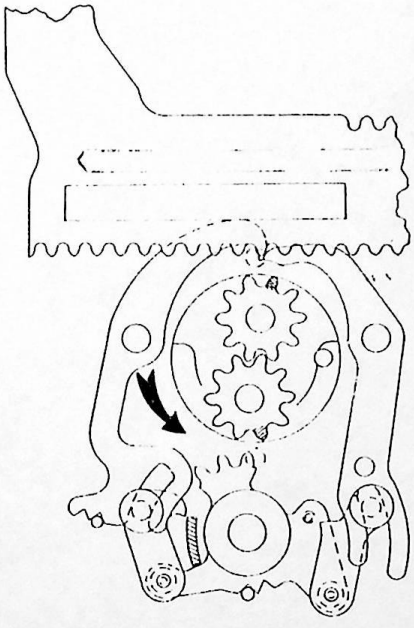
With decimal knobs at 0-0, depress total key and crank machine thru cycle. Enter '1'...depress plus key...crank machine thru cycle. Depress total key and crank thru cycle again. This provides a clear positive accumulator...plus gears all at '0'...minus gears all at '9'. We know that if a '1' is entered and the minus key depressed, the '1' will be added to the first column '9' of the minus gears, the remaining '9's' will be carried over to '0's' and in the first column...where the '1' was added to the '9' changing it to '0'...the '0' will be carried to a '1'.

Now let's examine how this happens....

With a clear positive accumulator, a '1' is entered and the minus key depressed. The accumulator is rotated into minus position.



Clear Positive Accumulator

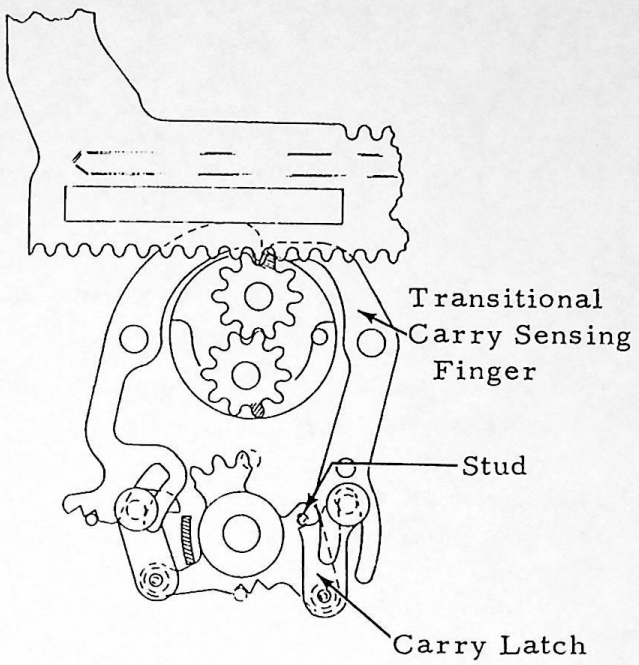


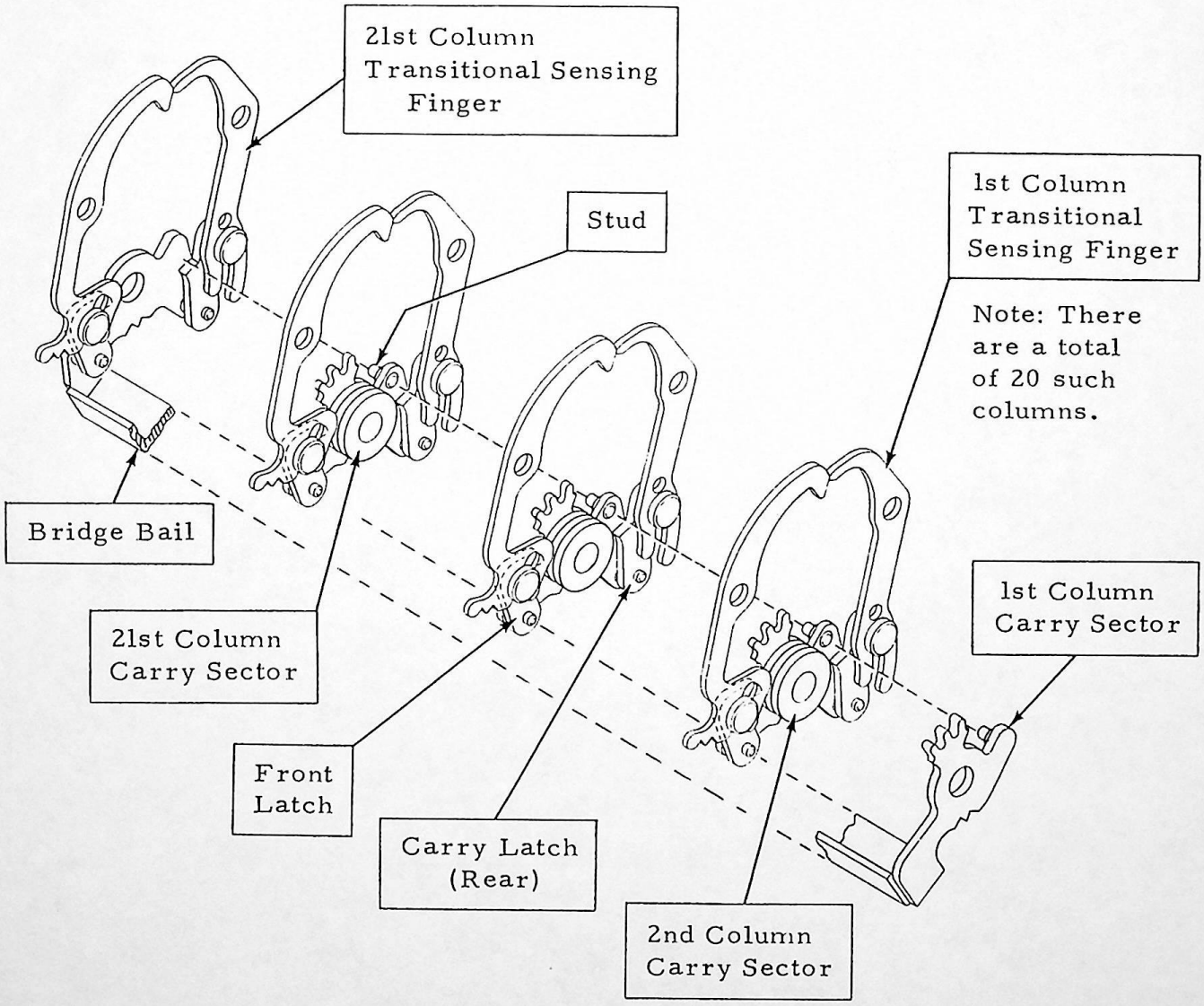
Minus Accumulator

The first column numeral rack moves one tooth space rearward before being stopped by the set-up carriage gear. The rack restoring bar moves fully rearward, the racks are aligned and the hammers fire.

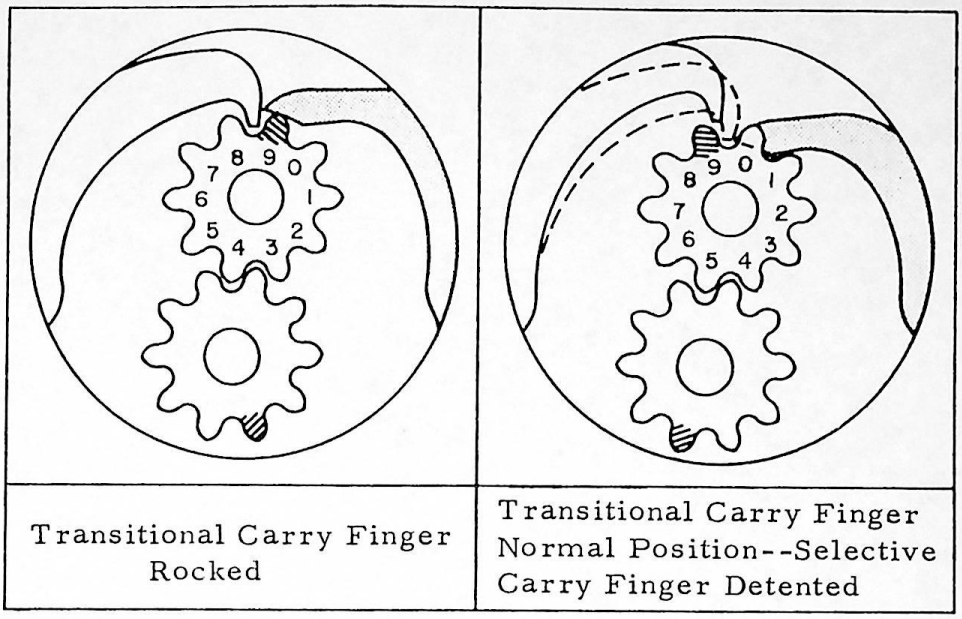
The accumulator moves up into mesh with the racks.

With all '9's' in the minus gears, all 21 transitional carry sensing fingers rock their carry latches forward... under the stud of the sector that is in the same column as the sensing fingers. These latches, however, are attached to the sector in the next higher order column. (For example: The first column gear rocks the first column sensing finger...which rocks the latch attached to the second column sector in under the pin of the first column sector.)



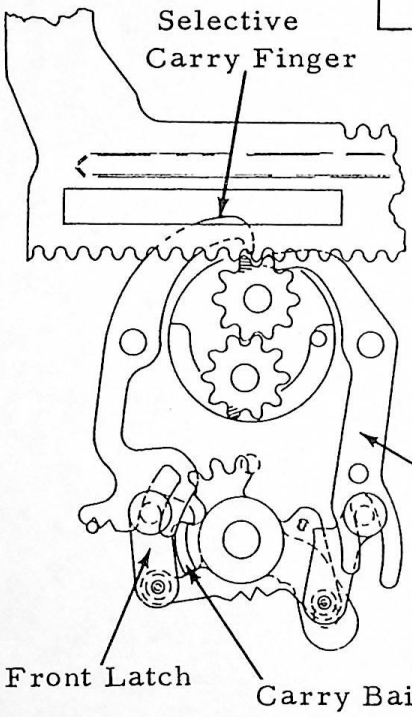


As the first column gear is displaced from '9' to '0' by the restoring of the first column print rack, the first column transitional sensing finger returns to its normal position...moving the latch attached to the second column sector out from under the pin of the first column sector.



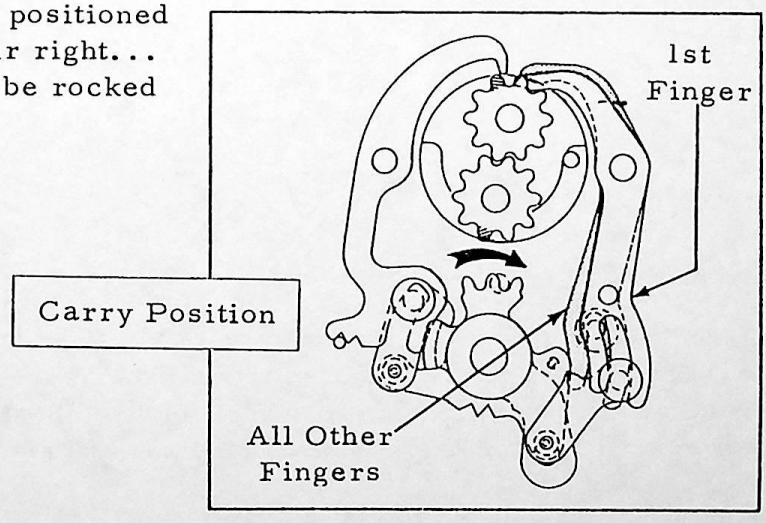
Transitional Carry Finger Rocked

Transitional Carry Finger Normal Position--Selective Carry Finger Detented

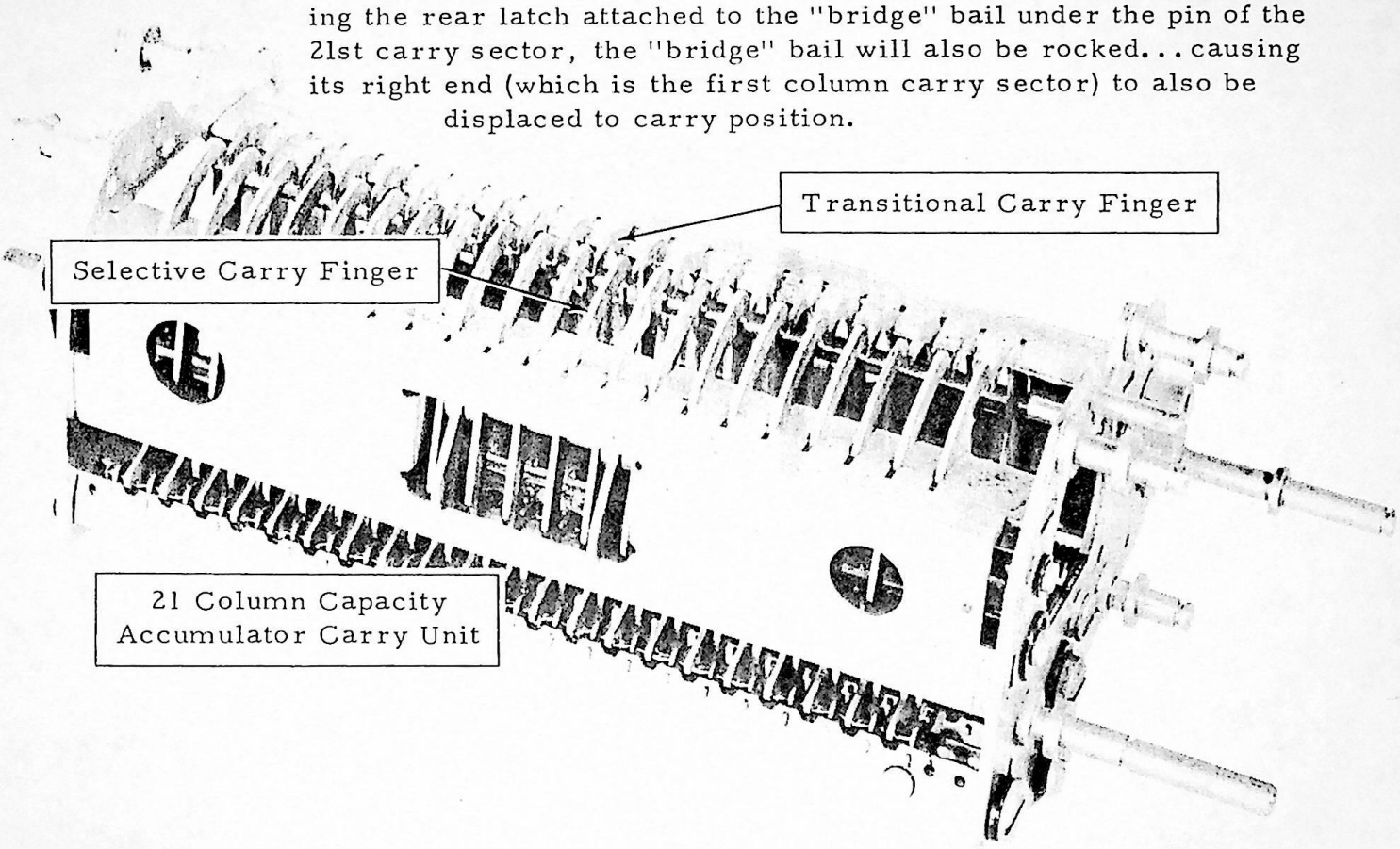


However, in displacing the gear from '9' to '0', the selective carry finger in the first column was detented to its "carry" position...moving the front latch attached to the second column sector over the carry bail.

As the carry bail is rocked, it will carry this front latch on the second column sector with it...rocking the sector rearward. The rear latches on all sectors to the left of the second column, being positioned under the pins of the sectors to their right... will cause all remaining sectors to be rocked rearward to carry position.

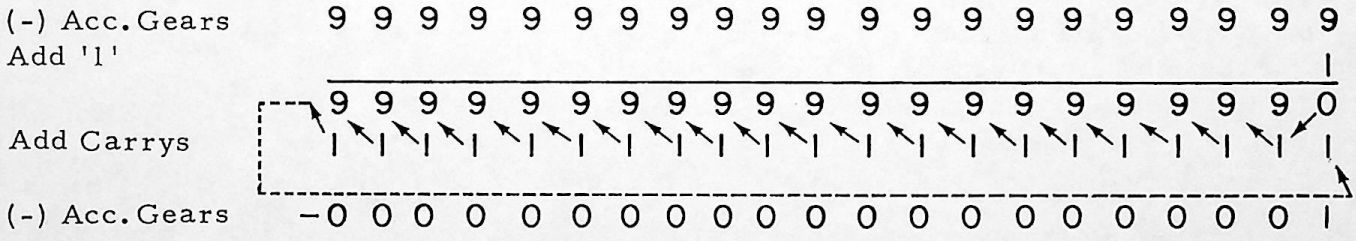


Since the accumulator capacity is 21 columns, there is no need for a 22nd carry sector. The front (selective) and rear (transitional) latches in this 21st column are, therefore, attached to a "bridge" bail which extends back across the accumulator to the right end...The right end of this "bridge" bail is the first column carry sector. Therefore, with the 21st transitional sensing finger holding the rear latch attached to the "bridge" bail under the pin of the 21st carry sector, the "bridge" bail will also be rocked...causing its right end (which is the first column carry sector) to also be displaced to carry position.

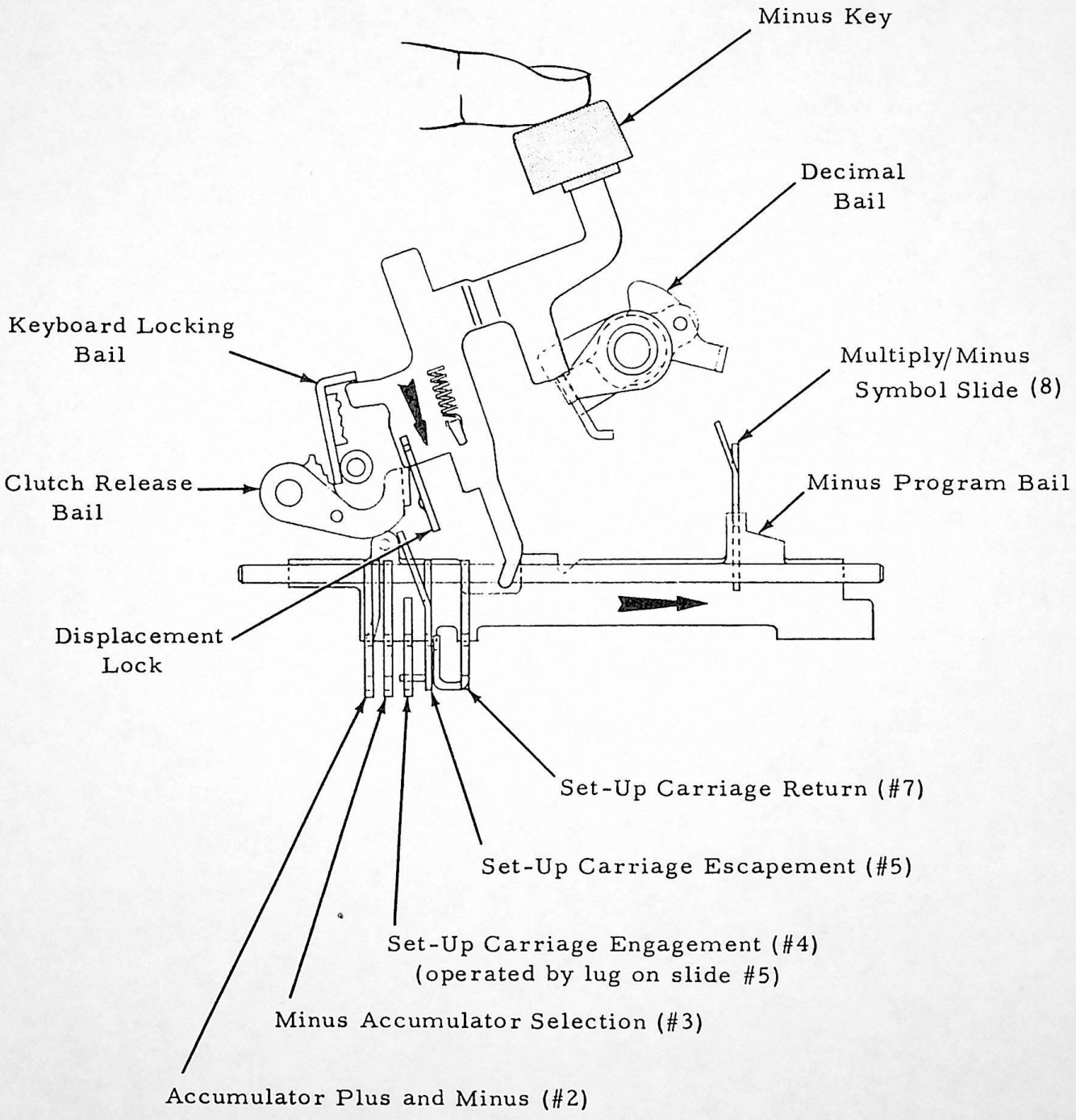


Then, the accumulator will be moved down into mesh with all the displaced carry sectors and the carry bail will be rocked to its normal position...carrying a '1' into every accumulator gear.

Representing the minus accumulator gears as dials, the foregoing operation can be diagramed as follows:



The arrows indicate the source of the carry...Arrows from above indicate a selective carry...while arrows from below indicate a transitional carry. The dotted arrow from the 21st column to the first column shows how a carry out of the 21st column is transmitted to the first column thru the "bridge" bail. This transmittal of a carry from the left end (highest order) column to the right end (lowest order) column is called an "end-around" carry.


Minus Key
Decimal Bail
Keyboard Locking Bail
Multiply/Minus Symbol Slide (8)
Clutch Release Bail
Minus Program Bail
Displacement Lock
Set-Up Carriage Return (#7)
Set-Up Carriage Escapement (#5)
Set-Up Carriage Engagement (#4)
(operated by lug on slide #5)
Minus Accumulator Selection (#3)
Accumulator Plus and Minus (#2)

The Minus Key, like the Plus Key, engages the keyboard locking bail, the clutch release bail, the displacement lock, and the decimal bail.

The minus key moves the minus program bail rearward into engagement with the program feed plate. The minus program bail is similar to the plus program bail. . . . They both activate the accumulator plus and minus program slide (#2), the set-up carriage escapement program slide (#5) (which operates the set-up carriage engagement program slide (#4)) and the set-up carriage return program slide (#7). The minus program bail differs from the plus program bail in that the minus bail activates the minus accumulator selection program slide (#3) and the mult. /minus symbol slide.

The program bail pushes the mult. /minus symbol slide to its full right position where its stop lug will engage the rearward step of the left symbol rack. . . stopping the rack when it has positioned the minus symbol on the symbol wheel in alignment with the platen.

The minus accumulator selection program slide (#3), thru its bell crank, pulls the minus accumulator selection control slide forward. The minus accumulator selection control slide raises the minus control bail which raises the accumulator positioning latch into the path of the minus positioning link causing the accumulator to be positioned in minus as described on page IV-E-18

The left "leg" of the minus accumulator control bail pushes the red print/credit balance control slide forward to select red print as described on page IV-D-18.

Besides raising the minus control bail, the minus accumulator selection control slide also cams the minus control bail to the right. This relieves the load of the minus control bail spring from the overdraft sensing pin.

NOTE: The overdraft mechanism will be covered in the "Negative Total" description under Total Key (Section IV-I).

John M. Dawson

-205 ✓
+405 ✓
-2106 ✓
+901
+1005

+	−
00000	99999
−205	+205
99795	100204
99794	00205
+405	−405
100199	99800
00200	99799
−2106	+2106
99894	100005
98093	01906
+901	−901
98994	01005
+1005	−1005
99999	00000

+123
-321
+1654
-156
+1
-1

+

123
00123
-321
99802
-1
99801
-654
00156
-456
00000
+1
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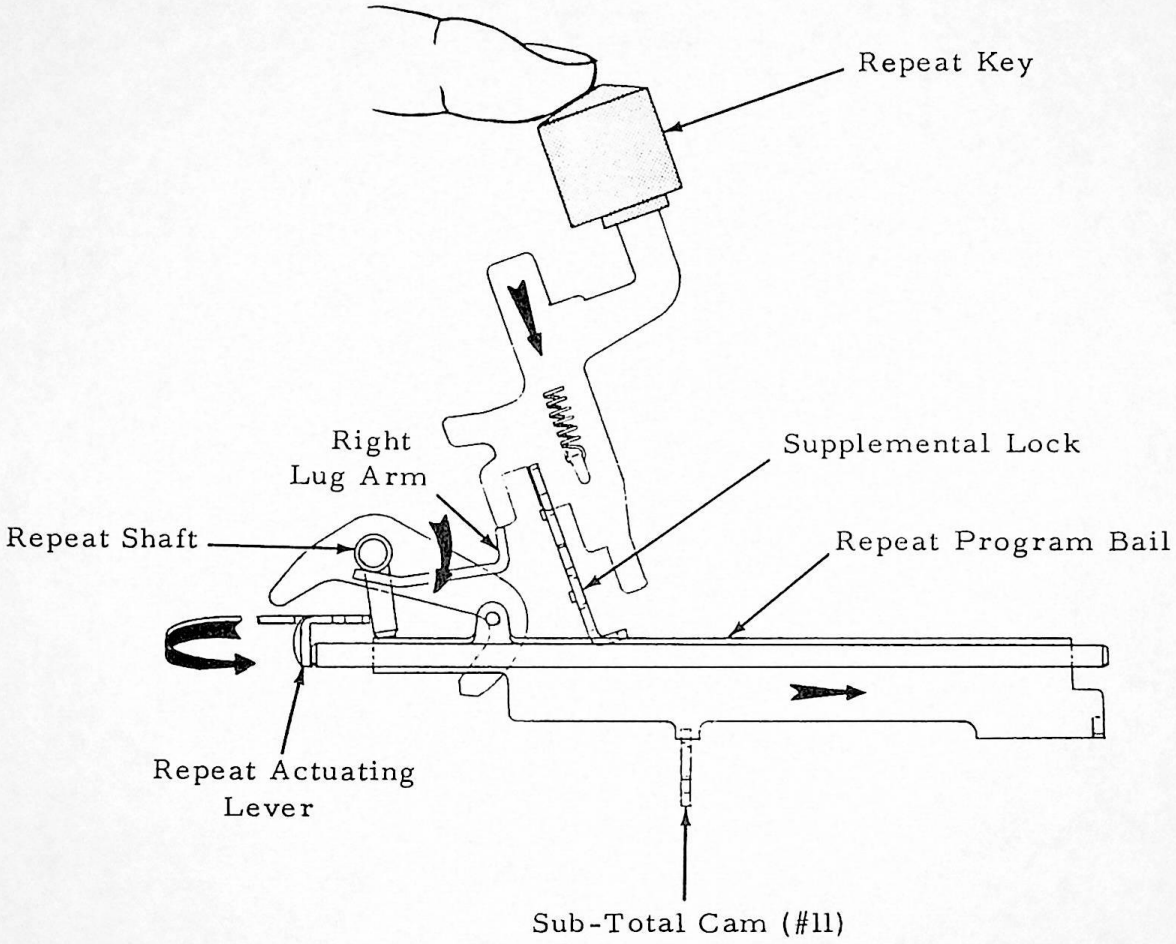
00000
-123
99877
99876
+321
00197
-654
99543
+456
99999
-1
99998


Repeat Key
Right
Lug Arm
Supplemental Lock
Repeat Shaft
Repeat Program Bail
Repeat Actuating
Lever
Sub-Total Cam (#11)

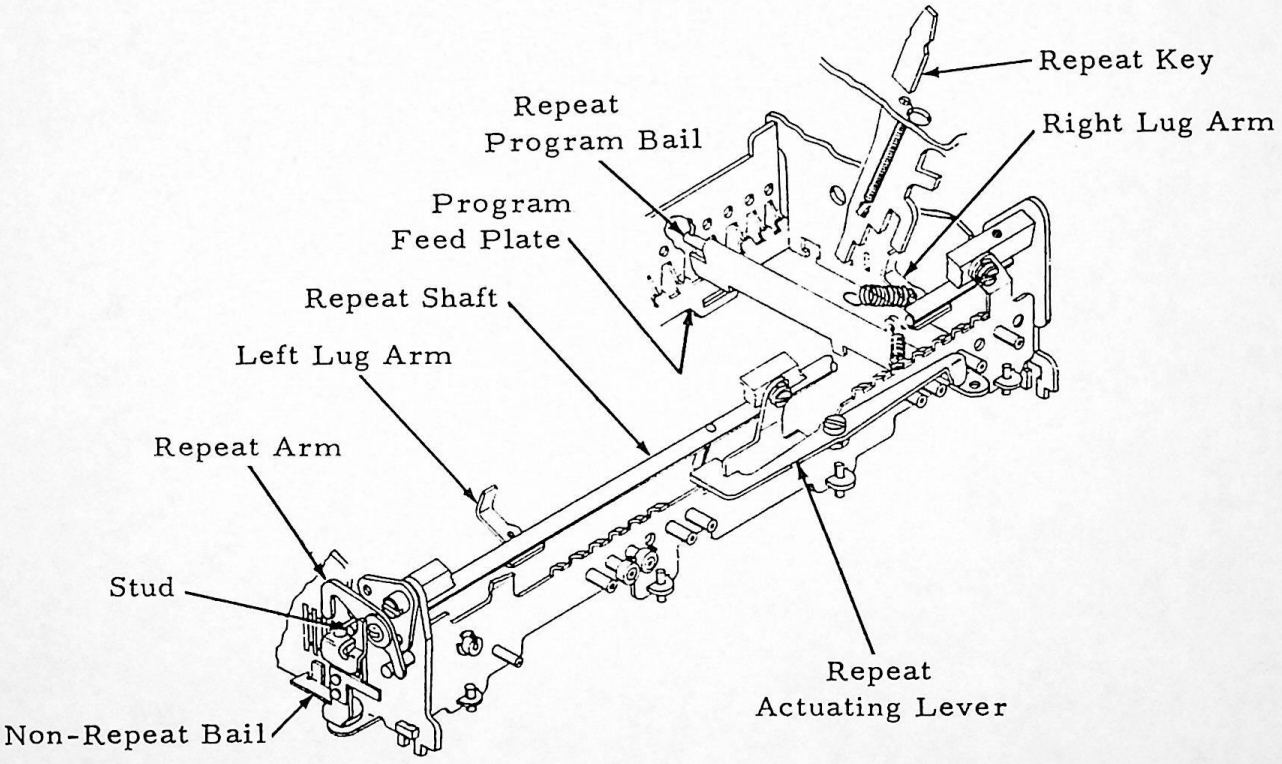
The Repeat Key is used with the Plus or Minus keys to enter the same amount more than once...without the necessity of re-setting the amount in the numeral keyboard.

The repeat key is a "dead key" in that it does not activate the clutch release bail... and thus does not initiate a machine cycle.

Use of the repeat key will alter the regular plus or minus program so that:

1. The set-up carriage is kept in mesh with the racks as the racks are restored to normal.
2. The set-up carriage return mechanism is disabled.
3. The single cycle latch is disabled.

When the repeat key is depressed it operates the supplemental lock to the right (see Page IV-A-7) and engages the lug of an arm on the right half of the repeat shaft... rocking the shaft (Note: There are two such "lug arms" on the repeat shaft. The other, on the left half of the shaft, is operated by the squaring key).



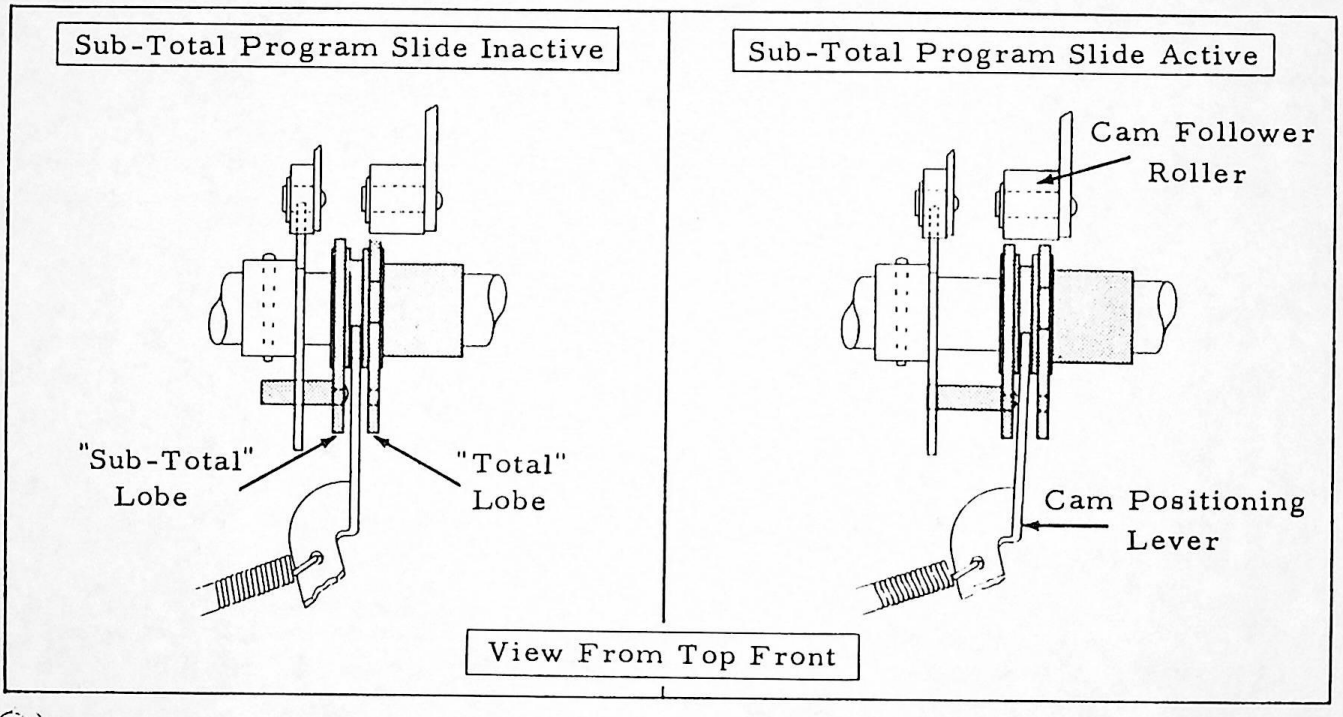
The "repeat arm" is attached to the left end of the repeat shaft.

As the repeat shaft rocks, a stud on the repeat arm pushes the non-repeat bail down and another stud, located near the center of the repeat shaft, pivots the repeat program bail actuating lever which pushes the repeat program bail into engagement with the program feed plate.

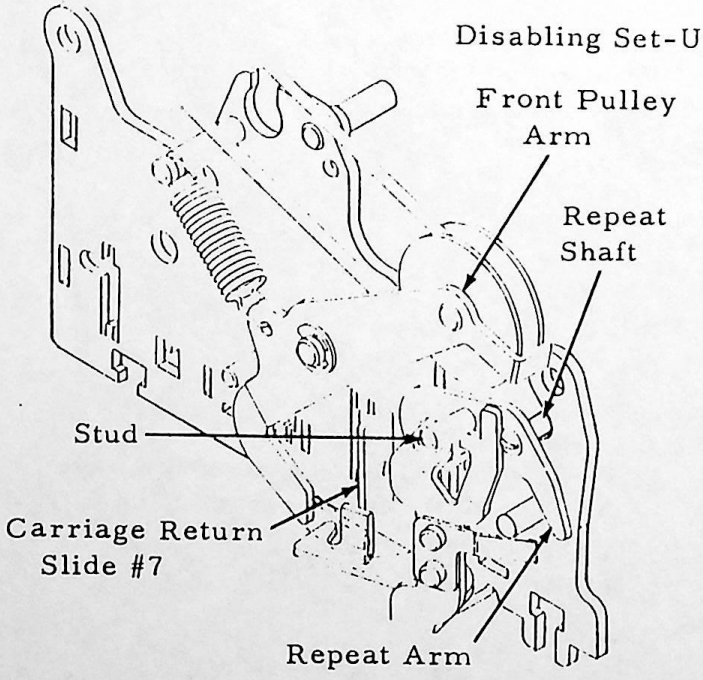
"Sub-Totaling" the Set-Up Carriage

On the program feed stroke (started by the plus or minus key), the repeat program bail operates the sub-total cam program slide. The sub-total cam program slide (#11) pivots the total/sub-total cam positioning lever. The positioning lever positions the total/sub-total cam so that both the total and sub-total lobes of the cam are aligned with the roller of the cam follower (normally only the total lobe is aligned with the roller). This is the cam follower which drives the #2 operating slide. The #2 operating slide carries the drive arm for engaging the set-up carriage with the racks (see pages IV-C-8 and IV-C-9). The total lobe of the total/sub-total cam causes the set-up carriage to engage the racks and, when the racks move to the rear and are aligned, the total lobe releases the set-up carriage. However, with the sub-total lobe "active", it keeps the set-up carriage in engagement with the racks until they are restored to normal position. This causes the amount to be re-entered in the set-up carriage.

Total/Sub-Total Cam

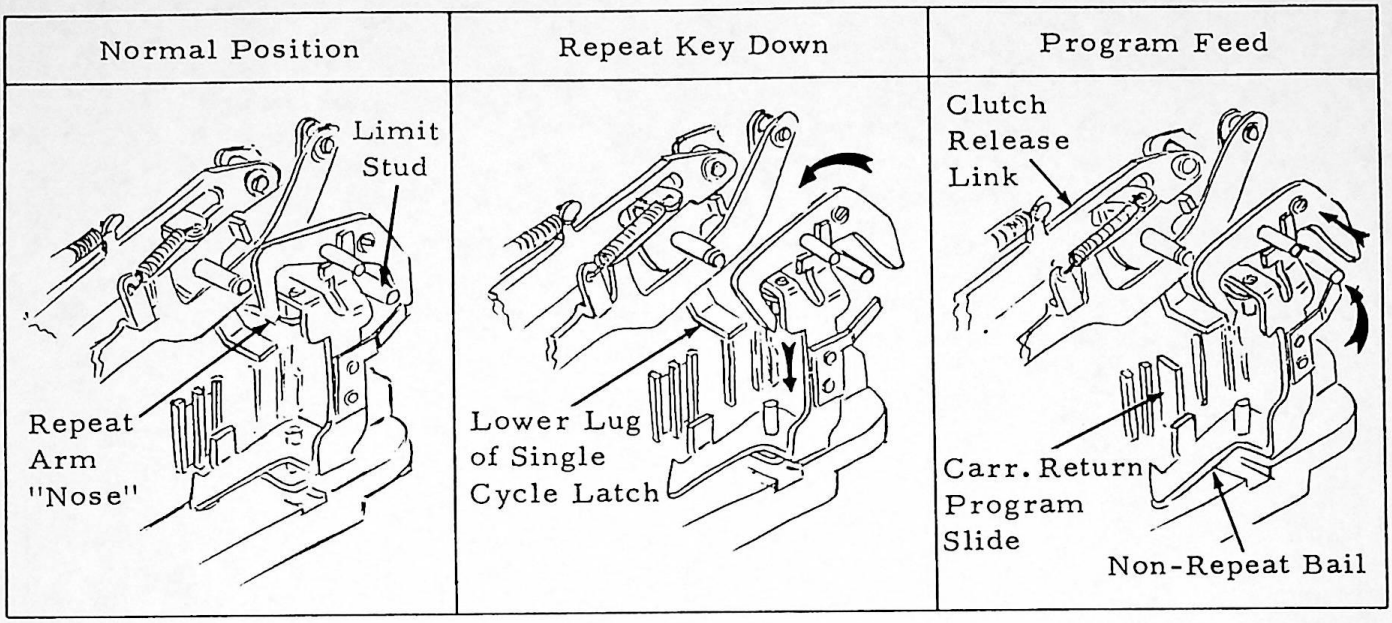


Disabling Set-Up Carriage Return



Also... on the program feed stroke, the plus or minus program bail (whichever was operated) moves the set-up carriage return program slide (#7) to the left. This movement pivots the non-repeat bail to what would normally be its active position to engage the lower end of the front pulley arm and cause the return of the set-up carriage. However, the stud of the repeat arm had pushed the non-repeat bail down so that, though activated, it still is not in the path of the lower end of the front pulley arm. This disables the carriage return action and leaves the set-up carriage in its escaped position.

Disabling the Single Cycle Latch



When the repeat arm was rocked, its "nose" moved down. . . . When the carriage return program slide pivots the non-repeat bail the upper extension of the bail pushes the repeat arm and repeat shaft to the right. This positions the "nose" of the repeat arm in front of the lower lug of the single cycle latch, which prevents the single cycle latch from engaging the clutch release link when the clutch release link is restored forward at the end of the cycle. This disabling of the single cycle latch permits the clutch release link to move rearward again starting another cycle. Repeat cycles will continue as long as the repeat and plus or minus keys are held down.

When the repeat key is released, the repeat shaft is restored to the left and pivoted to its normal position (with the tail of the repeat arm resting on limit stud) by the restoring spring on the right lug arm.

The non-repeat bail is raised and pivoted to its normal position by its own restoring spring as the carriage return program slide and the repeat shaft are restored to normal.

Adjustment

Total/sub-total cam position.

NOTE: This adjustment is made after the program feed adjustment (pages IV-B-7 and 8).

With the sub-total cam program slide (#11) inactive, the total cam lobe should have a full hold on the cam follower roller. . . . With the sub-total cam program slide fully activated, both the total and sub-total cam lobes should have full hold on the roller. (These two positions are illustrated on the preceding page). . . . Adjust as required by forming rear end of cam positioning lever.

Numeral Keyboard Repeat Lock

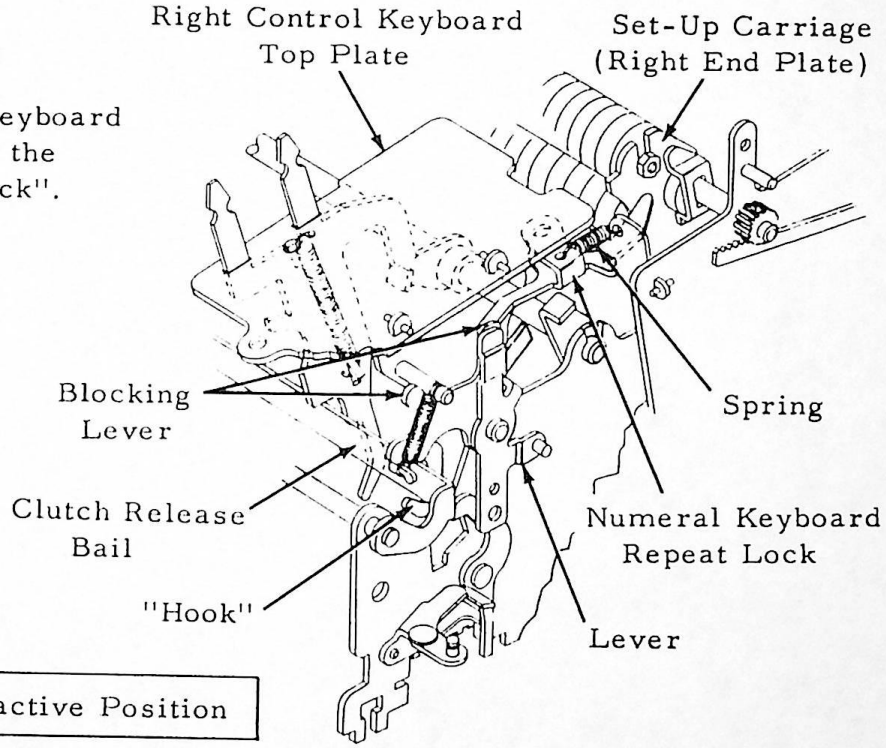
In performing repeat operations, the operator should release the repeat and plus or minus keys before the final cycle... then perform the final cycle with the plus or minus key alone. This procedure will clear and return the set-up carriage to "home" position on the final cycle.

If the final cycle is performed with the repeat key still depressed, then the clear key must be depressed to clear and return the set-up carriage.

If the set-up carriage is not returned -- (either on the final repeat cycle, or by depressing the clear key) following a repeat operation, the numeral keyboard will be locked. This is done to prevent the accidental setting of an amount... behind the previously set amount... when the operator neglects to clear the previously set amount.

The locking of the numeral keyboard is accomplished by means of the "numeral keyboard repeat lock".

NOTE: While the primary purpose of this lock is for repeat operations, as stated above, it should be noted that the lock will be activated whenever the set-up carriage contains an entry and a function is performed which does not call for a set-up carriage return.

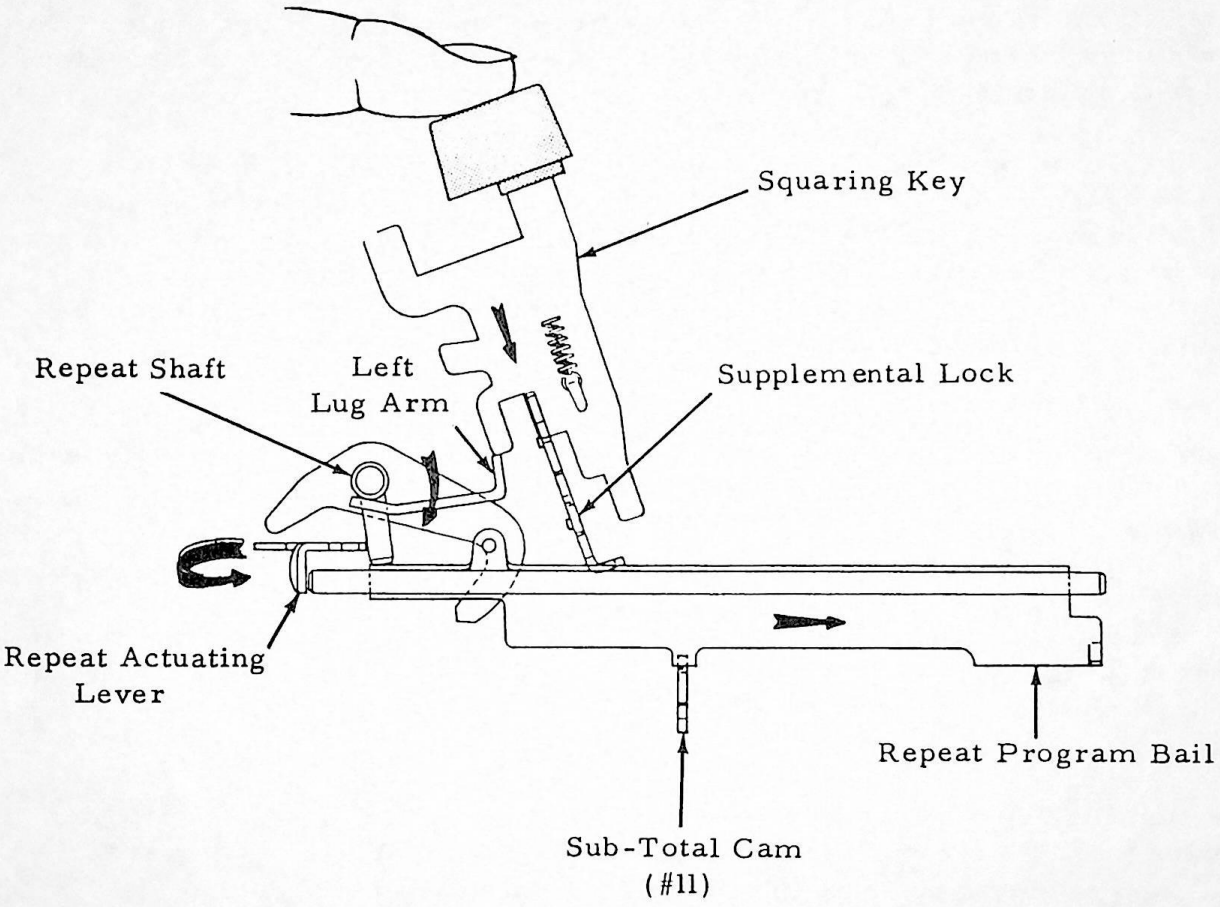


The numeral keyboard repeat lock is mounted on a stud under the right rear corner of the right control keyboard top plate. A rearward extension is contacted by the right end plate of the set-up carriage, when the set-up carriage is in "home" position. This contact holds the lock pivoted with its forward extension disengaged from the blocking lever. (inactive position)

When the set-up carriage moves to the left (away from the lock) as a result of a figure being entered, the lock spring starts to pivot the lock in a counter-clockwise direction. This pivoting however, is immediately stopped by the forward extension of the lock contacting the side of the blocking lever.

When any "live" function key is subsequently depressed, it will operate the clutch release bail. . . A "hook" extension of the blocking lever is positioned under the right end of the clutch release bail and the downward moving bail engages the hook causing the blocking lever to pivot. As the blocking lever pivots, its blocking extension moves forward. . .releasing the lock. (NOTE: The pivoting of the blocking lever is such that its hook will disengage from the clutch release bail after the blocking lever has released the lock but before the release bail is fully pivoted). The lock then pivots into the return path of the blocking extension and also into the path of the upper extension on another lever. This is the lever on the right end of the shaft which is rocked by the keyboard cross bar whenever a numeral key is depressed. (See page III-B-2). Key depression is thus blocked by the lock which prevents the cross bar shaft from being rocked.

When the set-up carriage is returned to "home" position, it pivots the lock to inactive position.


Squaring Key
Repeat Shaft
Left
Lug Arm
Supplemental Lock
Repeat Actuating
Lever
Repeat Program Bail
Sub-Total Cam
(#11)

While the Squaring Key is used in conjunction with the enter multiplicand key or any of the three multiplication keys, its function is nearly identical to that of the repeat key. Its purpose, like the repeat key, is to use the same entry more than once without the necessity of re-setting the amount thru the numeral keyboard. It, also, is a "dead key" in that it does not activate the clutch release bail to start a machine cycle.

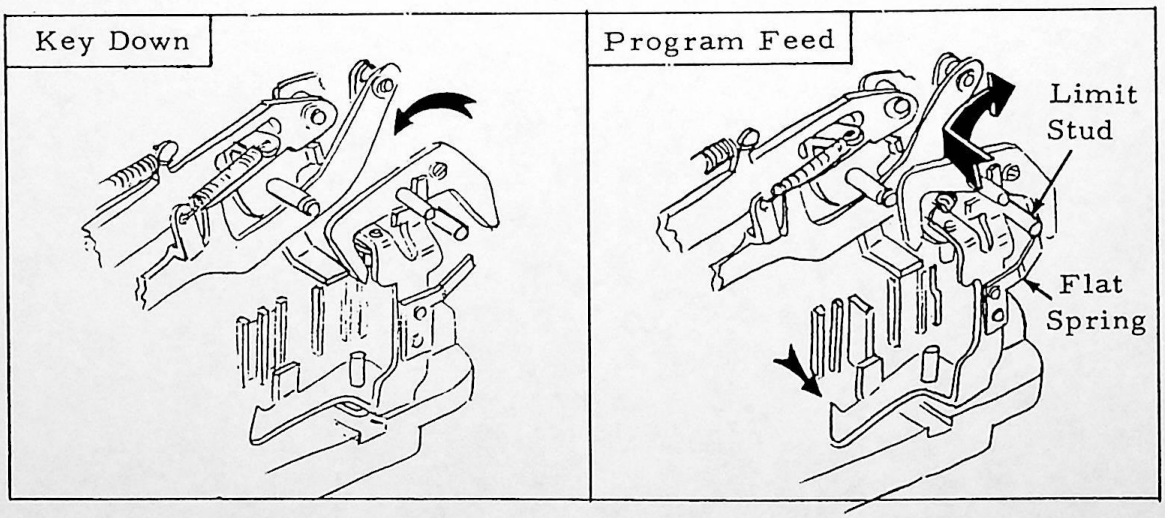
The squaring key, like the repeat key, will alter the regular program of the "live key" used with it (the enter multiplicand program or the first cycle program of the mult. keys). It keeps the set-up carriage engaged with the racks as they are restored and disables the carriage return mechanism. However...since the squaring key is intended to retain the set-up for two different operations...the single cycle latch must function in its normal manner. Therefore, the single cycle latch is not disabled on a squaring operation as it is on a repeat operation.

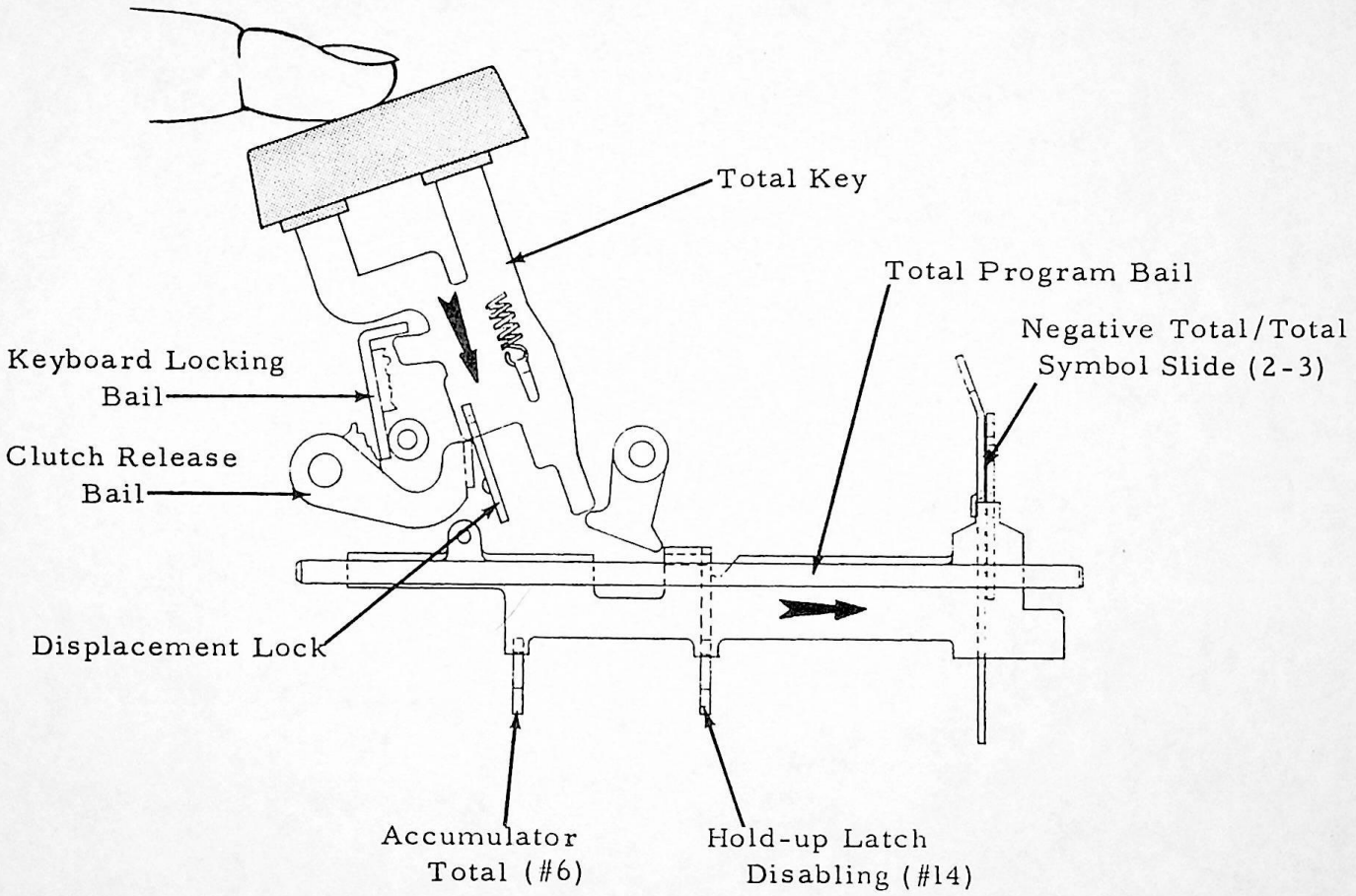
The left lug arm of the repeat shaft is positioned under the squaring key so that, when the repeat shaft is pushed to the right by the action of the carriage return program slide pivoting the non-repeat bail, the lug of the arm slides out from under the keystem. This permits the shaft, though still held to the right, to pivot back to its normal radial position. In this position the "nose" of the repeat arm does not disable the action of the single cycle latch.

The radial restoring of the repeat shaft would normally permit the non-repeat bail to rise up into the path of the front pulley arm (carriage return position). However, the flat spring of the non-repeat bail is positioned under the limit stud when the non-repeat bail is pivoted. This holds the bail down in its disabled position.

This radial restoring of the repeat shaft might also permit the repeat program bail to restore and release the sub-total cam program slide....To prevent this the tip of the repeat program bail has a lug forming which "hooks" the program feed plate. This holds the bail in its active position until the feed plate is restored near the end of the cycle.

On operations other than repeat and squaring, when the carriage return program slide pivots the non-repeat bail, the bail is in the up (active) position. In such instances, the flat spring contacts the end of the limit stud and yields.




Total Key
Total Program Bail
Negative Total/Total Symbol Slide (2-3)
Keyboard Locking Bail
Clutch Release Bail
Displacement Lock
Accumulator Total (#6)
Hold-up Latch Disabling (#14)

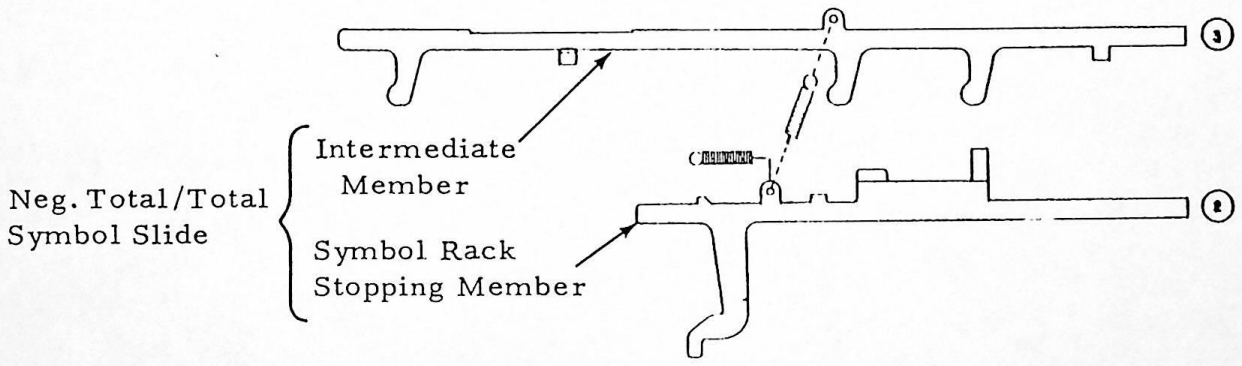
Depression of the total key operates the keyboard locking bail, the clutch release bail and the displacement lock. The lower end of the total keystem pivots a bell crank which pushes the total program bail into engagement with the program feed plate.

Operation of the clutch release bail causes the switch to be closed (Page II-A-2) and the main cam shaft clutch to be released (Page IV-C-2). With the motor running and the clutch released the main cam shaft starts to rotate. During the first 24° degrees of the cycle, the program feed plate is driven to the left by the program cam (Page IV-B-6).

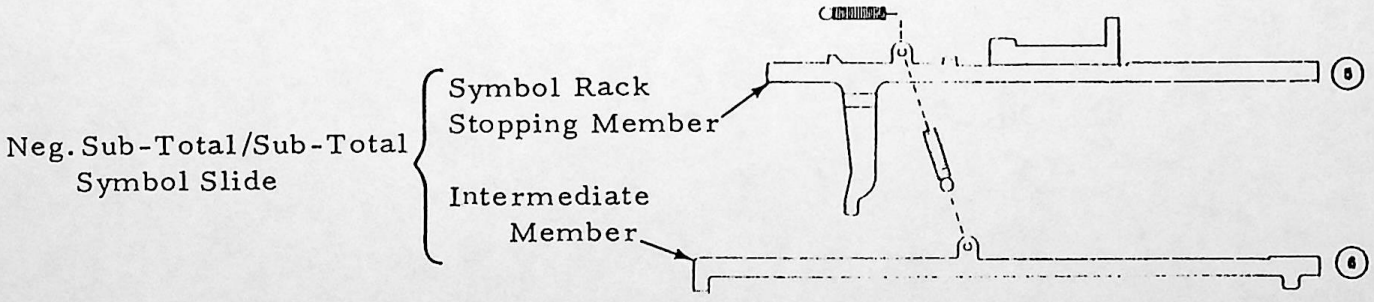
As the program feed plate is driven to the left, the total program bail activates the following program slides:

Accumulator Total	(#6)
Hold-Up Latch Disabling	(#14)

The total program bail also pushes the negative total/total symbol slide to the right. This symbol slide is one of the two flexible (two-piece) slides referred to previously on Page IV-D-2. Its two pieces are identified by the circled numerals 2 and 3



The other flexible symbol slide is the negative sub-total/sub total slide and its two parts are identified by the circled numerals 5 and 6.

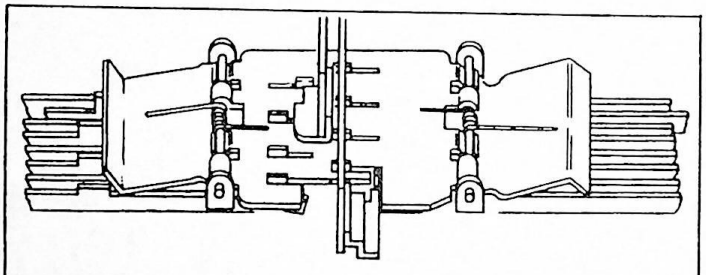


It was stated previously that five of the symbol slides are three position slides (left, inactive...half right, active and full right, active). These five symbol slides are each used to provide two different symbols. They are the Negative Total/Total slide (2-3), the Negative Sub-Total/Sub-Total slide (5-6), the Multiply/Minus slide (8), the Negative/Accumulative slide (9) and the Divide/Remainder slide (10). (Bracket numbers refer to circled numbers on Page IV-B-4).

In the case of the last three slides mentioned [(8), (9) and (10)], the mechanical arrangement is such that the amount of activating movement imparted to the slide is varied, either at the source of movement or at the point of contact with the slide, to select either of the two active positions.

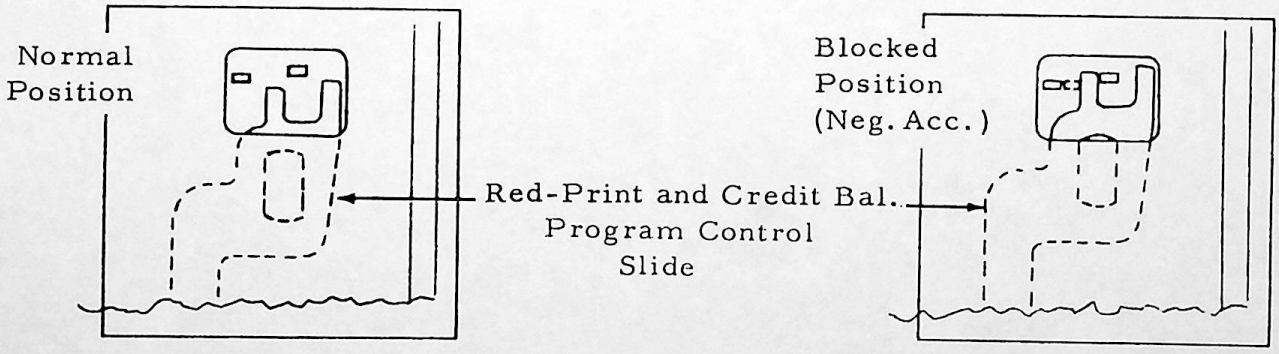
Such is not the case with the Negative Total/Total (2-3) and the Negative Sub-Total/Sub-Total (5-6) slides. These are both operated directly by their respective program bails (Total or Sub-Total) and the amount of activating movement is not varied. The program bails always move the members that they contact (intermediate members) to the full right position...and this is the reason for the flexing arrangement of these two symbol slides.

On a Total or Sub-Total program (including transfer) with a positive amount in the accumulator (or with a clear accumulator from which the last amount removed was positive), both members of either symbol slide (2-3 or 5-6) would be moved to the full right position where their stop lugs would contact the rearward step of the left symbol rack...stopping the rack when it had turned either the total or sub-total symbol on the symbol wheel into alignment with the platen.

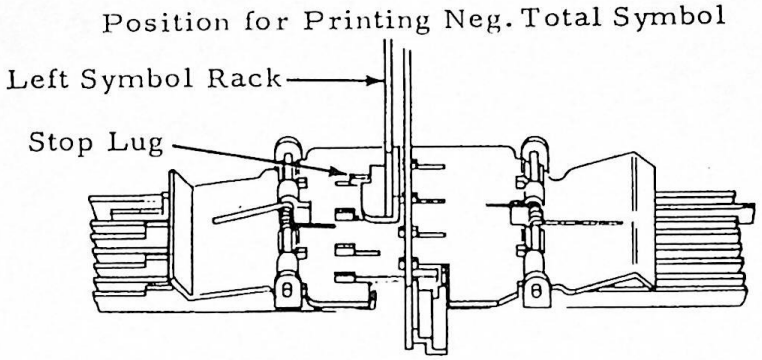


Position for Printing Total Symbol

On a Total or Sub-Total program with a negative amount in the accumulator (or with a clear accumulator from which the last amount removed was negative) the intermediate member of either slide (2-3 or 5-6) would be moved to the full right position by the active program bail...however, the symbol rack stopping member of either slide (the one containing the symbol rack stop lug) would only move with the intermediate member to the half right position. At this point the downward extending "leg" of the rack stopping member of either slide would contact a lug on the forward end of the red-print and credit balance program control slide.



The rack stopping member would thus be stopped in the half right position while the intermediate member continued to the full right position...flexing the connecting spring. The stop lug of either slide (2-3) or slide (5-6) would then be positioned to contact the forward step of the left symbol rack...stopping the rack when it had positioned either the negative total or negative sub-total symbol on the symbol wheel in alignment with the platen.



The illustration shows the symbol rack stopping member of the neg. total/total symbol slide (2-3) in half right position...its stop lug contacting the forward step of the left symbol rack.

The following chart shows the symbols on each symbol wheel and identifies the symbol slides which control them.

LEFT SYMBOL WHEEL			RIGHT SYMBOL WHEEL		
SLIDE (Ref. No. from Page IV-B-4)	SYMBOL Half Right	SYMBOL Full Right	SLIDE (Ref. No. from Page IV-B-4)	SYMBOL Half Right	SYMBOL Full Right
Neg. Total/Total (2-3)	±	+	Dividend (1)		÷
Neg. Sub-Total/Sub-Total (5-6)	≥	≤	Non-Add (4)	#	
Multiply/Minus (8)	=	–	Multiplicand (7)		×
Divide/Remainder (10)	÷	R	Neg./Accum. (9)	–	+

The following is a list of the individual symbols and combinations of symbols as they are related to specific functions along with the possible variations in the control and result of such functions.

FUNCTION - SYMBOL CHART

FUNCTION	VARIABLE FACTORS (Listed only when they effect symbol)			SYMBOL
	ACC. CONDITION	TRANSFER CONTROL	CONST./QUOT. TR. CONTROL	
Minus				-
Total	Pos.			✲
Total	Neg.			✲
Sub-Total	Pos.			◊
Sub-Total	Neg.			◊
Non-Add				#
Multiplicand				×
Tr. Multiplicand	Pos.	Total		✲ ×
Tr. Multiplicand	Neg.	Total		✲ ×
Tr. Multiplicand	Pos.	Sub-Total		◊ ×
Tr. Multiplicand	Neg.	Sub-Total		◊ ×
Dividend				÷
Tr. Dividend	Pos.	Total		✲ ÷
Tr. Dividend	Neg.	Total		✲ ÷
Tr. Dividend	Pos.	Sub-Total		◊ ÷
Tr. Dividend	Neg.	Sub-Total		◊ ÷
Multiply				=
product				✲
Accum. Multiply				= +
product				✲
Neg. Multiply				= -
product				✲
Divide			Const. Divisor	÷ ×
quotient				✲
remainder				[illegible]
Divide			Quotient Tr.	÷
quotient				✲ ×
remainder				[illegible]

Total With Positive Accumulator

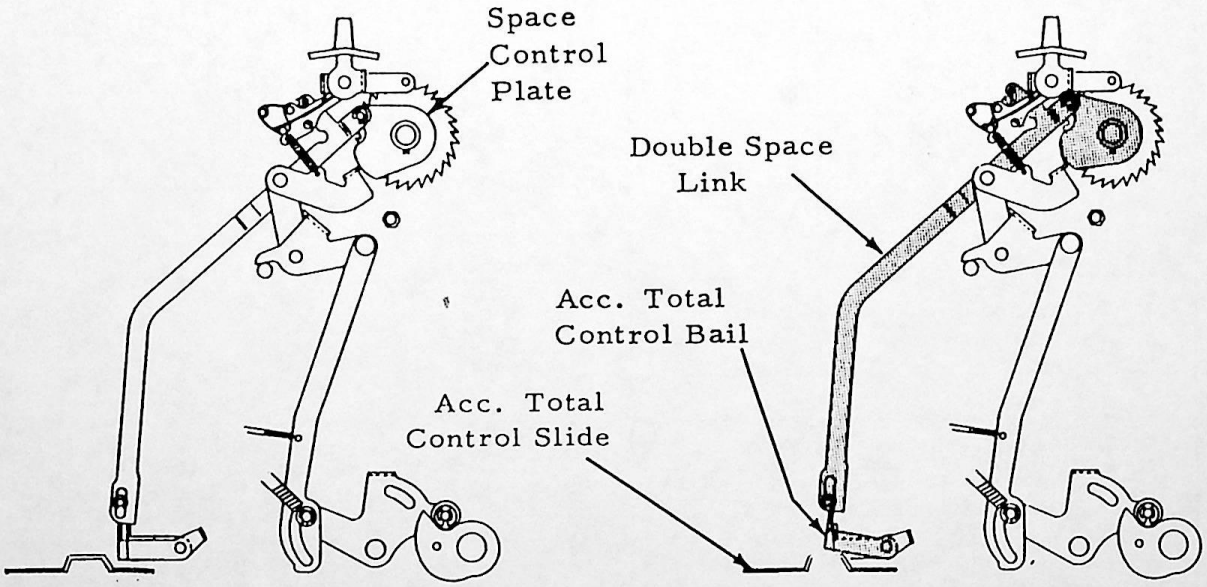
On a positive total function, both members of the neg. total/total symbol slide are positioned full right for total symbol (*) printing.

It was noted previously that the total program bail also activated the accumulator total (#6) and hold-up latch disabling (#14) program slides. The function of the hold-up latch disabling program slide (#14) is described on page IV-C-12.

Regarding the hold-up latch, it should be noted that as the main cam shaft cycles thru hold-up position, the roller on the hold-up latch roller arm moves into... then out of the notch in the hub of the carriage return/platen space cam. This "in-out" movement permits the three decimal shafts in the decimal unit to be pulled slightly to the left by their spring...then pushes them back to the right to their normal position. This is the movement which releases the hold-up latch and aligns the set-up carriage with the racks on functions in which the set-up carriage is engaged. On a total function however, the set-up carriage is not escaped or engaged and the movement has no affect on its position. Also, since the hold-up latch was already moved out of the path of the clutch pawl by the disabling lever, the movement does not cause its release. This movement therefore is simply incidental to the design and not a required action on functions which do not employ the set-up carriage.

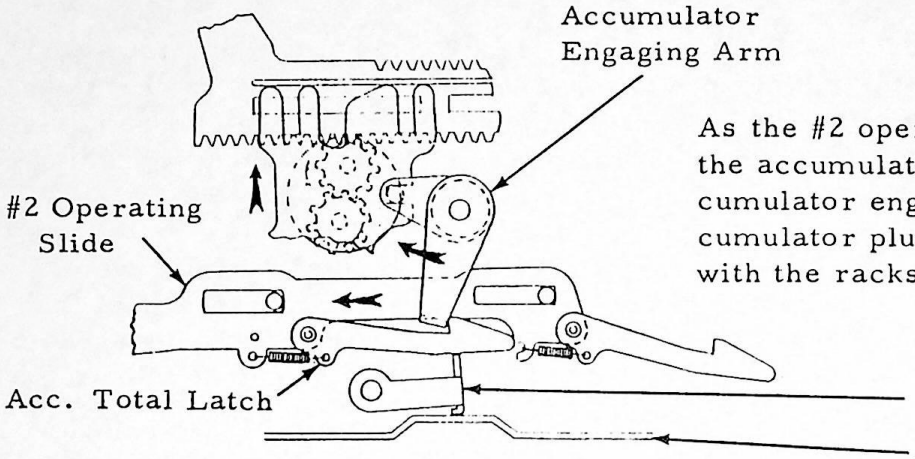
The accumulator total program slide (#6) operates a bell crank which pulls the accumulator total control slide forward... raising the accumulator total control bail.

An extension on the left end of the accumulator total control bail raises the double space link to double space position. This moves the space control plate to the same position that the platen space control lever moves it when set in double space position. (See Page IV-D-17). The accumulator total control bail raises the accumulator



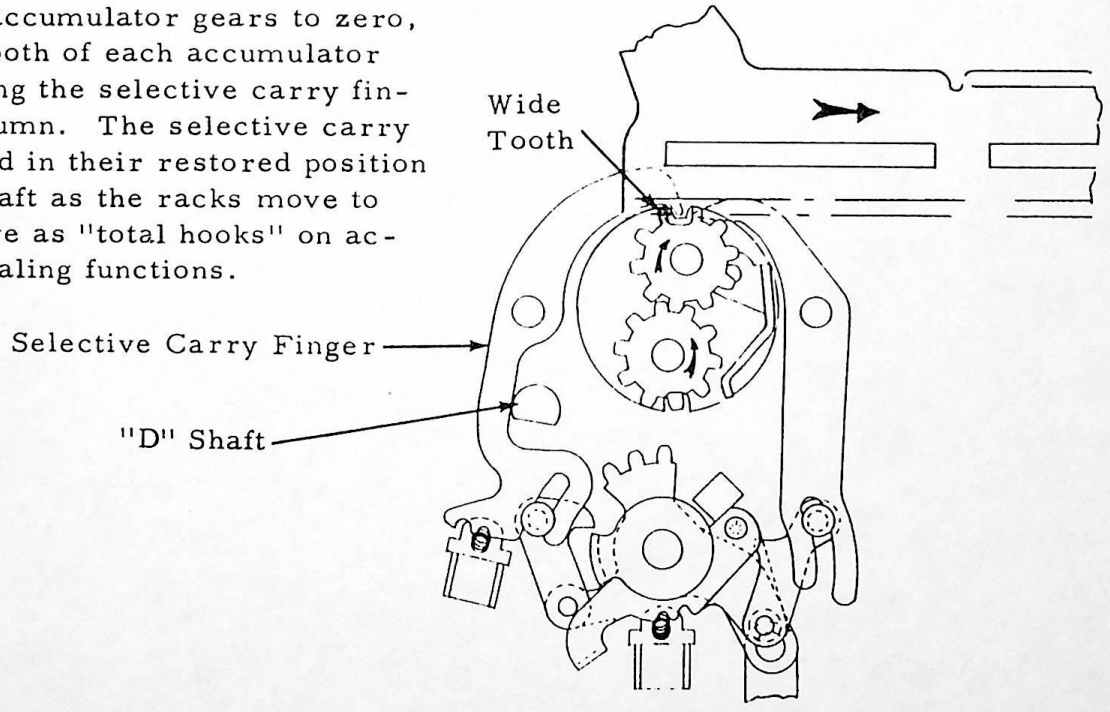
total latch on the #2 operating slide (Page IV-E-22) into alignment with the accumulator engaging arm.

NOTE: The #2 operating slide (the same one which engages the set-up carriage with the racks on other operations) is moved to its forward position by the total lobe of the total/sub-total cam before the racks are released by their restoring bar.



As the #2 operating slide moves forward, the accumulator total latch pivots the accumulator engaging arm... raising the accumulator plus gears into engagement with the racks.

The rack restoring cam follower springs now pivot the rack restoring cam followers as the follower rollers move into the low section of the rack restoring cams. This pulls the rack restoring bar to the rear. The racks representing the amount in the accumulator (if any) are pulled toward the rear by their springs. They will be stopped individually, when they have turned their accumulator gears to zero, by the wide tooth of each accumulator gear contacting the selective carry finger in its column. The selective carry fingers, locked in their restored position by the "D" shaft as the racks move to the rear, serve as "total hooks" on accumulator totaling functions.



As the racks move from restored position they cam down the decimal activator bail and, while the rack restoring bar is moving to the rear, the decimal cam rocks its cam follower. This engages the upper decimal selecting bar slide with the decimal control fingers at the selected decimal position, which corresponds to the combined setting of the two decimal control knobs.

The movement of the racks to the rear removes the amount from the accumulator and transfers it to the print wheels. Also, while the rack restoring bar is moving to the rear, the print hammer cam rocks its cam follower. The cam follower pivots the hammer restoring arms, the hammer latch raising bail and the hammer release bail. The hammer restoring arms pivot the hammer restoring bar and ribbon raising bail and move the ribbon feed pawls to the rear.

Just as the rack restoring bar reaches the end of its rearward travel, the rack aligner cam starts to drive the aligner pawls into engagement with the ratchet teeth on the underside of the racks. At the same time, the hammer release bail releases the print hammers which are "fired" against the platen by their springs... printing the total amount with the total (*) symbol.

As the racks are engaged by the aligner pawls, the total/sub-total cam follower spring pivots the cam follower as its roller moves down into the low section of the total lobe. This restores the #2 operating slide to the rear... releasing the accumulator engaging arm and the accumulator is moved down out of egagement with the racks to its "middle" position by the centralizing spring.

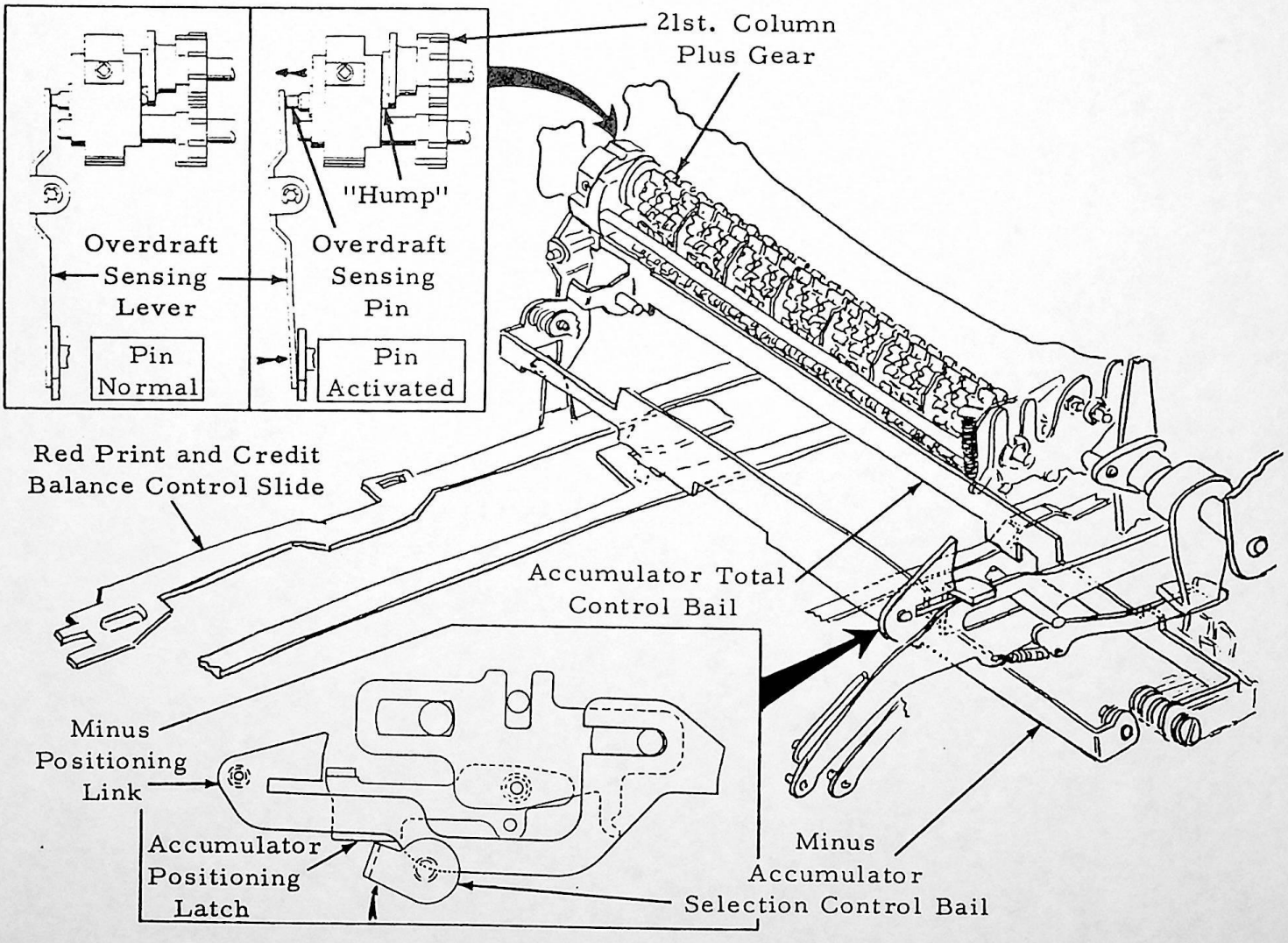
With all of the functional "work" having been performed on the first half of the cycle, the second half of the cycle simply consists of restoring the activated mechanism to its normal position. The platen is double spaced.

Total With Negative Accumulator

NOTE: "Overdraft", "Credit Balance" and "Negative Total" are all terms used to describe the condition of the accumulator when it contains a negative amount in relation to a zero (clear accumulator) starting point.

The "overdraft" mechanism senses such a negative condition and provides the means to engage the minus accumulator gears when totaling.

This overdraft sensing takes place at the 21st column plus accumulator gear. A flat section of the gear hub engages a flat section on the hub of a cam so that the gear and cam turn together. Whenever the 21st column plus gear registers a "9", a "hump" on the face of the cam pushes the overdraft sensing pin to the left. The overdraft sensing pin, sliding thru the center of the left accumulator bearing sleeve, pushes the top of the overdraft sensing lever. This pivots the lever (counter clockwise as viewed from the front)...moving the lower end of the lever to the right. The lower end of the lever is thus positioned where it will hold the minus accumulator selection control bail to the right...where the bail was cammed by its control slide when the negative amount was entered. With the bail in this position, the upper surface of its left end is positioned under the offset lug on the left end of the accumulator total control bail....Therefore, with a "9" in the 21st plus accumula-

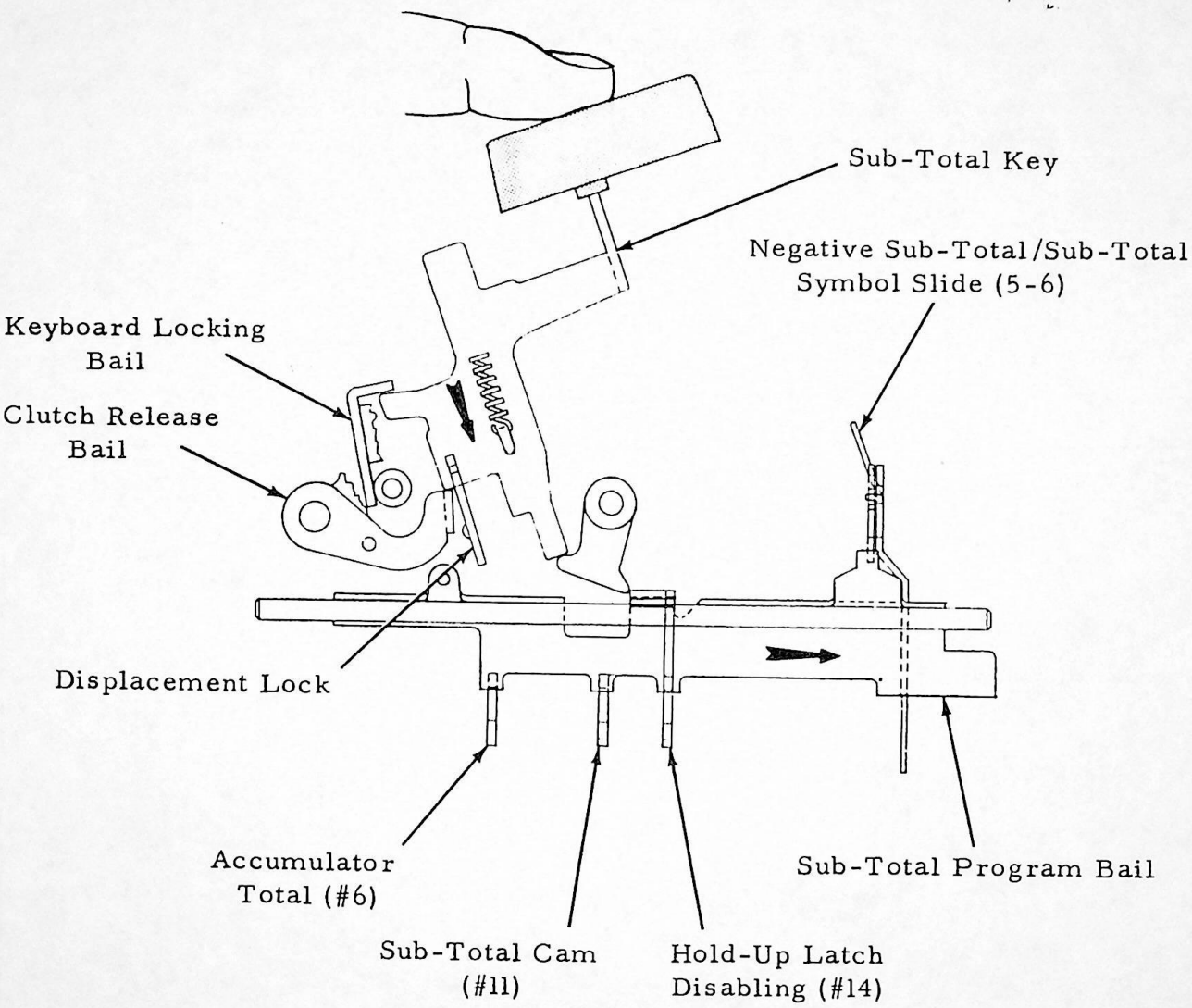


tor gear, the raising of the accumulator total control bail will cause the minus accumulator selection control bail to also be raised. The raising of the minus accumulator selection control bail will raise the accumulator positioning latch into the path of the minus positioning link... causing the accumulator to be positioned in minus as described on Page IV-E-18. Therefore, the total will be taken from the minus accumulator gears.

When the minus accumulator selection control bail was raised, the lower extension on its left end engaged an offset lug of the red print and credit balance control slide ...pushing the slide forward. This forward movement pivots the color control arm to red print position (see Page IV-D-19 for more details). It also positions the blocking lug on the forward end of the slide in the path of the downward extending leg of the symbol rack stopping member of the negative total/total symbol slide. This blocks the rack stopping member of the symbol slide in the half right position where it will contact the forward step of the left symbol rack... stopping the rack when it has positioned the negative total symbol on the left symbol wheel in alignement with the platen.

NOTE: On negative sub-totals the other blocking lug on the forward end of the red print and credit balance control slide blocks the rack stopping member of the negative sub-total/sub-total symbol slide in the same manner for printing of the negative sub-total symbol.

NOTES

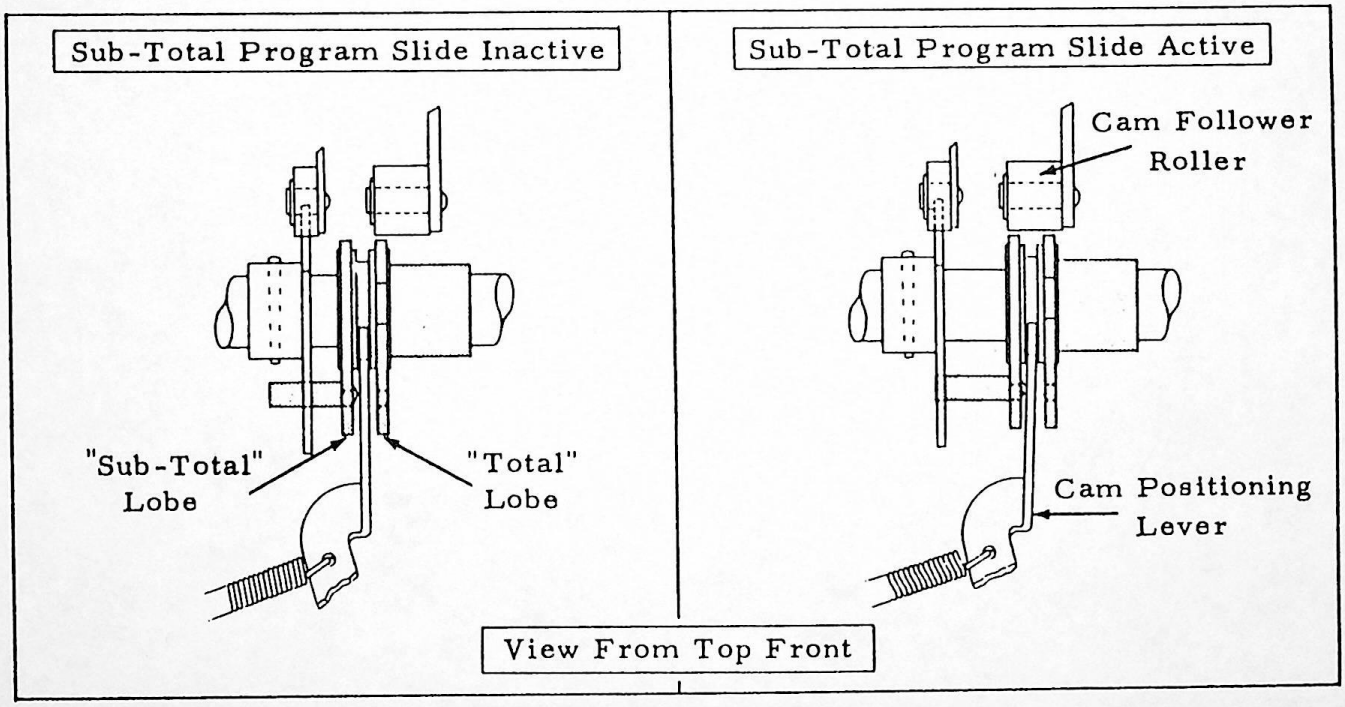

Sub-Total Key
Negative Sub-Total/Sub-Total Symbol Slide (5-6)
Keyboard Locking Bail
Clutch Release Bail
Displacement Lock
Accumulator Total (#6)
Sub-Total Cam (#11)
Hold-Up Latch Disabling (#14)
Sub-Total Program Bail

The sub-total program is exactly the same as the total program with two exceptions:

1. The sub-total program bail activates the negative sub-total/sub-total symbol slide instead of the negative total/total symbol slide.

2. In addition to program slides #6 (accumulator total) and #14 (hold-up latch disabling) the sub-total program bail also activates the sub-total cam program slide (#11). Therefore, as the program feed plate moves to the left at the beginning of the cycle, the sub-total cam program slide pivots the cam positioning lever. The cam positioning lever moves the total/sub-total cam to the right so that both the total lobe and the sub-total lobe of the cam are aligned with the cam follower roller.

Total/Sub-Total Cam



Since this is the cam follower which drives the #2 operating slide, the sub-total lobe of the cam will hold the #2 operating slide in its forward position until the end of the second half of the cycle. This will keep the accumulator gears engaged with the racks as the racks are being restored to normal position... causing the amount to be re-entered in the accumulator.

John Mc Hannon

100

1C-1h21 TEST #2

1. The non-add key when depressed will operate which of the following?

A. Keyboard locking bail.
Clutch release bail.
Supplemental lock.
Non-add program bail

B. Keyboard locking bail.
Clutch release bail.
Non-add program bail.
Decimal bail.
Displacement lock.

(C.) Keyboard locking bail.
Clutch release bail.
Displacement lock.
Non-add program bail.

2. The non-add program bail will operate which of the following during the first 24° of the machine cycle?

A. Set-up carriage engagement program slide.
Set-up carriage return program slide.
Non-print/non-space program slide.
Hold-up latch disabling.

(B.) Set-up carriage engaging program slide.
Set-up carriage return program slide.
Hold-up latch disabling program slide.
Non-add symbol slide.

C. Set-up carriage engaging program slide.
Set-up carriage return program slide.
Hold-up latch disabling program slide.
Non-print /non-space program slide.
Non-add symbol slide.

3. Which of the following is the proper sequence of hammer firing?

A. Hammer latches are raised.
Hammer restore bar is raised.
Hammer release bail raises.
Hammers are fired.

B. Hammer restore bar is raised.
Hammer release bail is raised.
Hammer latches are raised.
Hammers are fired.

(C.) Hammer restore bar is raised.
Hammer latches are raised.
Hammer release bail is raised.
Hammers are fired.

4. Give the limits, in proper sequence, of the hammers during a zero non-add function.

A. Hammer restoring bar

B. Hammer release bail

C. Hammer latch

5. What is the one thing that has to take place in order to print a decimal?

A numeral rack has to go to the rear of the machine to lower the activator arm.

6. Place a check by the following statement, or statements that are true.

A. The short prongs of the decimal selecting slides will position the decimal control fingers in the path of the hammer latch fingers.

(B.) The long prongs of the decimal selecting slides are used to engage the decimal control fingers for the printing of zeros to the left of a significant digit.

(C.) The short prongs of the selecting slides will engage decimal control fingers for the printing of commas, in order to separate the whole numbers into groups of three.

D. Three decimal point print slides will be activated on every print operation regardless of the figure being printed.

7. With a decimal setting of 6 - 4, which of the following is correct?

(A.) Upper slide--Behind the 11th decimal control finger.
Middle slide--Behind the 5th decimal control finger.
Lower slide--Behind the 7th decimal control finger.

B. Upper slide---Behind the 10th decimal control finger.
Middle slide--Behind the 4th decimal control finger.
Lower slide---Behind the 6th decimal control finger.

C. Upper slide---Behind the 11th decimal control finger.
Middle slide--Behind the 7th decimal control finger.
Lower slide---Behind the 5th decimal control finger.

8. The machine has to be programed for which of the following operations?

A. Black print

(B.) Red print

9. Which of the following is the proper sequence of print wheel aligner operation?

A. Pivots at the aligning stud and the intermediate gear.
Pivots at the nose of the aligner and the "V" notch of the print wheel.
Pivots at the restoring stud.

(B.) Pivots at the restoring stud.
Pivots at the aligning stud and the intermediate gear.
Pivots at the nose of the aligner and the "V" notch of the print wheel.

C. Pivots at the restoring stud.
Pivots at the nose of the aligner and the "V" notch of the print wheel.
Pivots at the aligning stud and the intermediate gear.

D. Pivots at the aligner tail.
Pivots at the restoring stud.
Pivots at the aligning stud and the intermediate gear.
Pivots at the nose of the aligner and the "V" notch of the print wheel.

10. The print hammer cam and cam follower drives which of the following mechanisms?

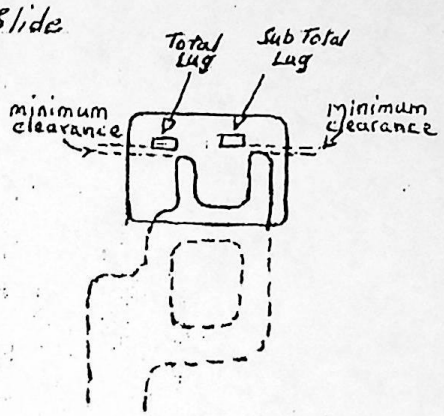
(A.) Hammer firing mechanism.
Ribbon feed and reversing mechanism.
Ribbon raising bail.

B. Hammer firing mechanism.
Platen feed mechanism.
Ribbon feed and reversing mechanism.

C. Hammer firing mechanism.
Ribbon raising bail.
Ribbon feed and reversing mechanism.
Decimal actuator arms.

Total Key Checks

1 Red Print and Credit Balance Program Control Slide

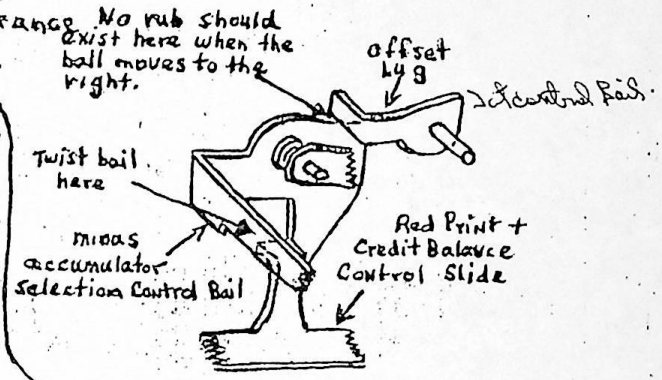


Check for minimum clearance of the Control Slide and the Total - Sub Total lugs.

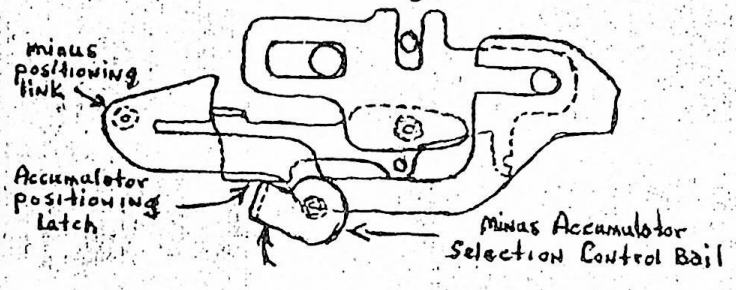
This can be adjusted at the Accumulator Total Control Bail by twisting the bail.

However, caution should be taken not to create a bind or rubbing condition between the control bail and the offset lug under the left end of the accumulators during a negative total.

Make adjustment to obtain the best clearance. No rub should exist here when the bail moves to the right.


offset Lug
Accumulator Total Control Bail
Twist bail here
Minus accumulator selection Control Bail
Red Print + Credit Balance Control Slide

2. Check that the Minus Accumulator Selection Control Bail pushes the Accumulator Positioning Latch upward into full engagement with the Minus Positioning Link.



3. Check that the Minus Accumulator Selection Control Bail does not bind on the bottom edge of the right hand side frame.

4. Check that the Overdraft Sensing Lever pushes the Minus Accumulator Selection Control Bail far enough to the right for a full hold on the offset lug and Accumulator Positioning Latch.

5. Check the Accumulator Total Control Bail raises the double space link. (Adjustment IV-D-17)

11-30-67

PC-1421 TEST #4

1. The repeat key through direct contact operates what mechanisms when depressed?
2. The repeat program bail operates what mechanism during 1st 24^{o}?
3. Explain how the carriage return and single cycle mechanisms are disabled on a repeat function.
4. What is the function of the numeral keyboard repeat lock and when will it be used?
5. Explain the difference between a repeat and a square operation, and how this difference is accomplished.
6. What slides will be operated by the total program bail during the first 24^{o}?
7. What mechanism is used to block the total and sub-total symbol slides on negative totals and negative sub-totals?
8. On a positive total when the accumulator total control bail is operated, first 24^{o}, what 2 mechanisms will be operated?
9. What mechanism stops the accumulators at zero during totaling?
10. Explain how an overdraft is signaled in the accumulators.
11. On a negative total when the accumulator total control bail is operated, first 24^{o}, what mechanisms will be operated?

John McNamara

#1. Depression of the repeat key operates the supplemental lock & the repeat shaft (note: the repeat shaft operates the repeat program bail).
Note: the keyboard locking bail is used to lock the repeat key, but it is operated by a line function) NOT part of the function

#2. During the first 240° of machine cycle, the repeat program bail operates the total - sub total cam into the path of the cam follower on the # 2 operating slide.

#3. The carriage return check is disabled on a repeat cycle by the now-repeat bail being lowered by the repeat arm. The single cycle check is disabled on a repeat operation by the now-repeat bail being pivoted by the set up carriage return slide & thereby the active repeat arm moved into the path of the lower offset of the single cycle latch.

#4. The function of the numeral keyboard repeat lock is to prevent entry of numbers into the set-up carriage if the set up carriage was not returned (after a repeat operation) to its home position (it is returned by use of the clear key or releasing both keys before the last cycle & then depressing the operating key).

The lock is used primarily for repeat operations but it is active anytime the set up carriage is out of the home position & a line function key is depressed.

#5. The difference between a repeat & regular operation is that on a regular operation, only one machine cycle can be taken.

The difference is accomplished by the repeat shaft, when moved to the right, is allowed to pivot radially and this moves the nose of the repeat arm out of the path of the lower extension of the single cycle latch.

#6. During the first 24° of machine cycle, the total program bail operates the accumulator total slide, the hold up disabling slide, & the total symbol intermediate slide.

#7. The red-print = credit balance slide forward end is used for blocking the symbol slide on negative functions. (It is operated by the minus accumulator selection control bail).

#8. The accumulator total control bail operates the double space cam, & also raises the outside center latch on the #2 operating shaft during the first 2½° of machine cycle.

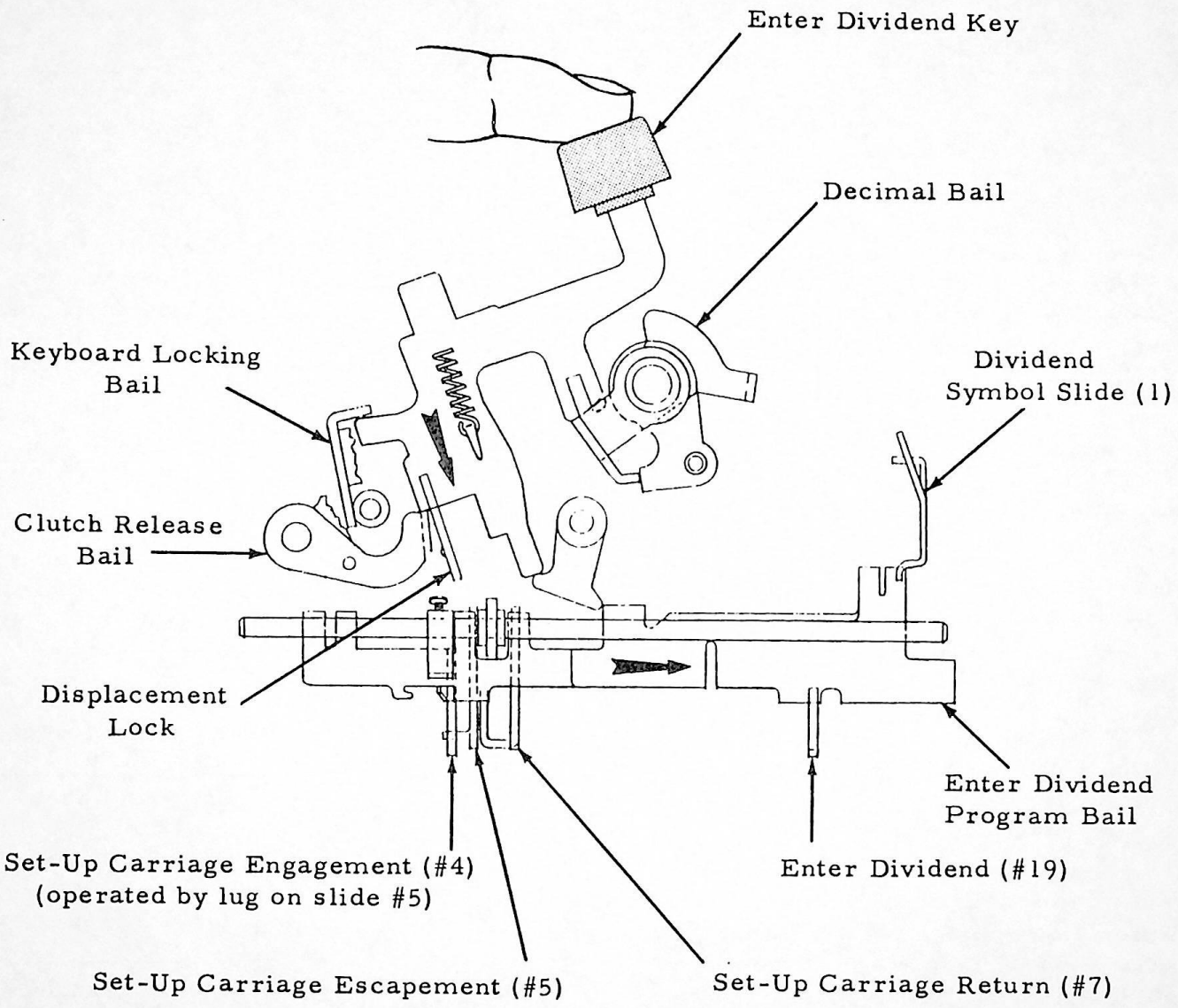
#9. The selection carry fingers stops the accumulators during the ~~[illegible]~~ totaling operation.

#10. An overdraft is signaled to the accumulators by a 9 in the 21st position accumulator gear. (This positions the sensing pin, which moves the sensing flap, which moves the minus accumulator control link, etc.)

#11. The accumulator total control bail ~~[illegible]~~ operates the double space cam, the accumulator total latch, & the minus accumulator selection control bail. The minus accumulator selection control bail positions the red print credit balance slide forward, & raises the accumulator positioning latch into the path of the minus positioning link. Pivots Color Control arm.

SECTION V

HIGH SPEED CALCULATING MECHANISM


Enter Dividend Key
Decimal Bail
Keyboard Locking Bail
Dividend Symbol Slide (1)
Clutch Release Bail
Displacement Lock
Enter Dividend Program Bail
Set-Up Carriage Engagement (#4) (operated by lug on slide #5)
Enter Dividend (#19)
Set-Up Carriage Escapement (#5)
Set-Up Carriage Return (#7)

Depression of the Enter Dividend Key operates the keyboard locking bail, clutch release bail and the decimal bail... and engages the displacement lock. The lower end of the enter dividend key pivots a bell crank which pushes the enter dividend program bail into engagement with the program feed plate.

As the program feed plate is driven to the left, the enter dividend program bail activates the following program slides:

Set-Up Carriage Escapement (#5)
which activates the Set-Up Carriage Engagement (#4)

Set-Up Carriage Return (#7)

Enter Dividend (#19)

The enter dividend program bail also pushes the dividend symbol slide (1) to its full right position where its symbol rack stop lug will stop the rearward travel of the right symbol rack by contacting its rearward stop step when the rack has positioned the dividend symbol on the symbol wheel in alignment with the platen.

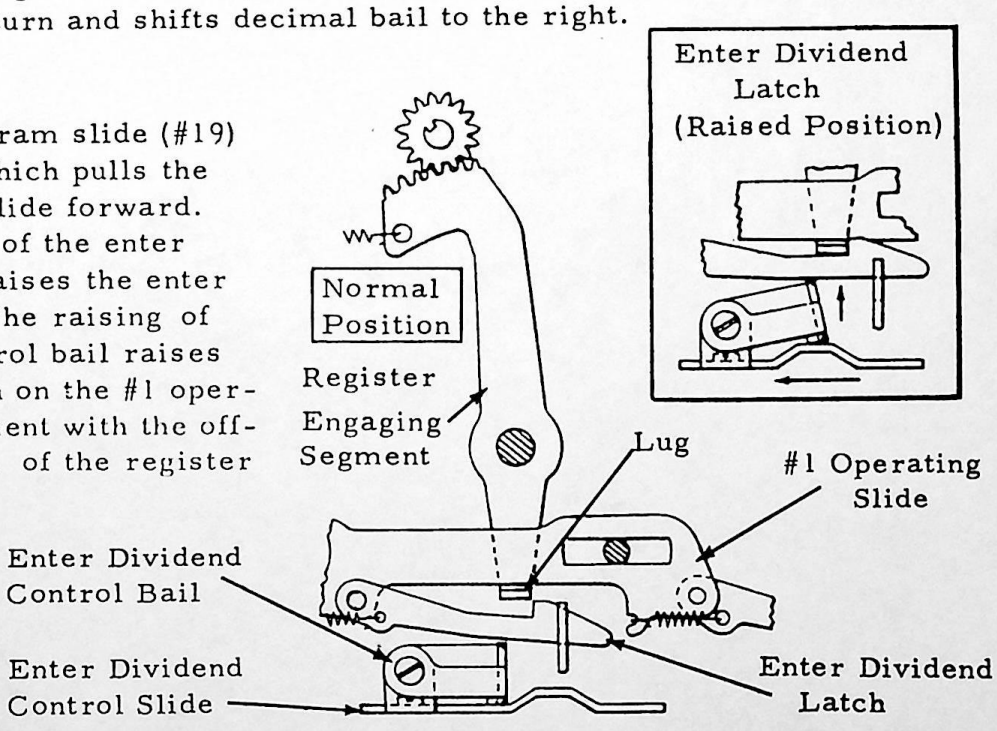
The functions of program slides #4, #5 and #7 have been described previously .... To summarize:

a. Program slide #4 activates the drive arm on #2 operating slide for engaging the set-up carriage with the racks.

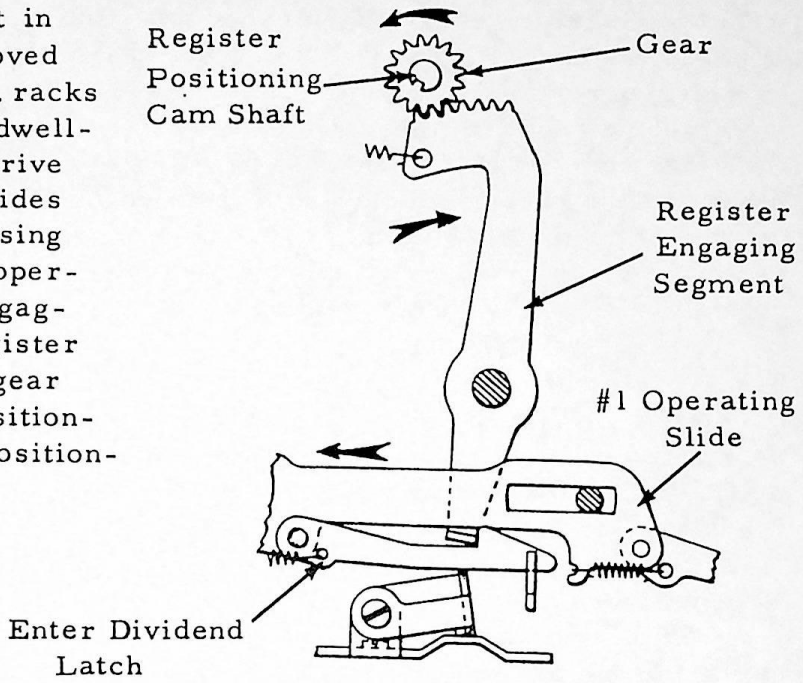
b. Program slide #5 escapes set-up carriage or operates alternate hold-up release arm... depending on decimal setting.

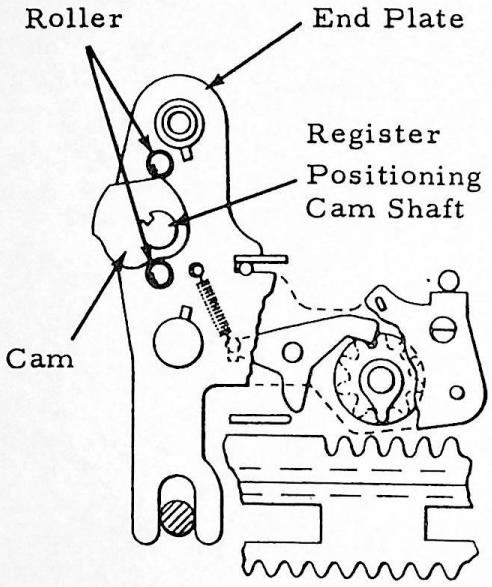
c. Program slide #7 positions non-repeat bail for carriage return and shifts decimal bail to the right.

The enter dividend program slide (#19) operates a bell crank which pulls the enter dividend control slide forward. The forward movement of the enter dividend control slide raises the enter dividend control bail. The raising of the enter dividend control bail raises the enter dividend latch on the #1 operating slide into engagement with the offset lug on the lower end of the register engaging segment.



Therefore, when the half-way point in the cycle is reached (amount removed from set-up carriage... printed... racks aligned... and rack restoring bar dwelling in its rearward position) the drive cam for the #1 and #3 operating slides will rock these slides forward causing the enter dividend latch on the #1 operating slide to pivot the register engaging segment. The teeth of the register engaging segment, in mesh with a gear on the right end of the register positioning cam shaft, turns the register positioning cam shaft.

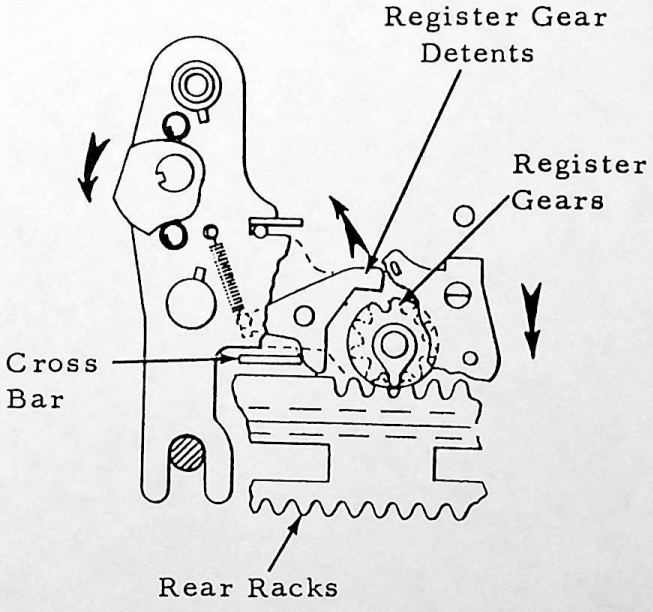




There are two cams on the register positioning cam shaft.... They are located at the outside of either end plate of the register unit. The cams are "caged", top and bottom, by rollers on the end plates.

The top rollers normally rest on a high section of the cams. The turning of the cam shaft moves this high section out from under the rollers and another high section of the cams around to the bottom rollers... driving the register down so that the register gears mesh with the racks.

As the register gears move into mesh with the racks, the lower tails of the register gear detents contact a cross bar of the rear rack unit which cams the detents out of engagement with the register gears.



With the register gears fully meshed with the racks, the drive cam for operating slides #1 and #3 will dwell, holding the gears in mesh while the rack restoring cam moves the rack restoring bar forward. The forward restoring of the racks enters the dividend figure in the register gears. After the racks have been fully restored the drive cam for the #1 and #3 operating slides will move the slides to the rear... releasing the enter dividend latch from engagement with the register engaging segment. The segment will be pivoted to normal position by its spring. This will raise the register up out of engagement with the racks to normal position and the detents will re-engage the register gears.

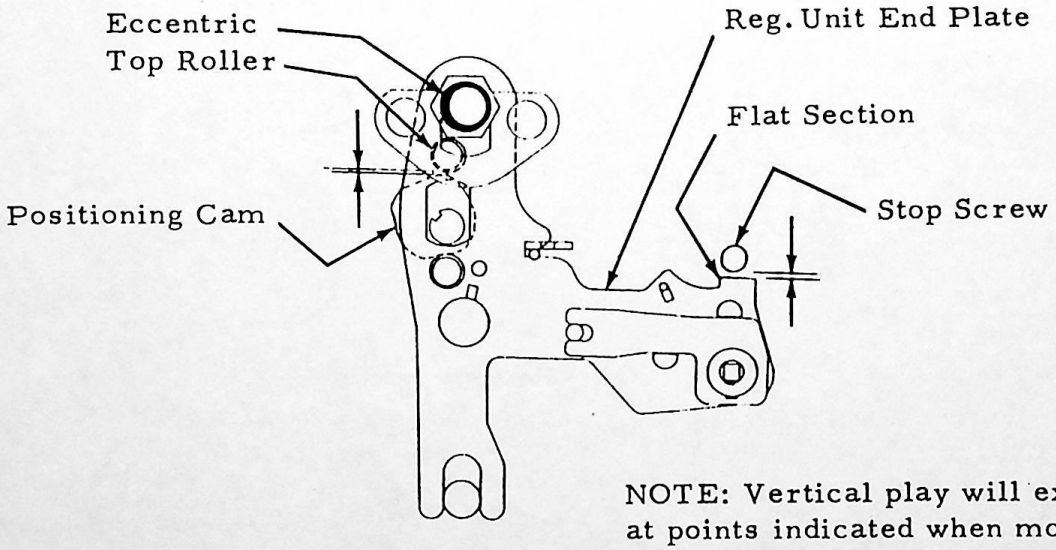
The register unit end plates each have a flat section at the top of their rearward extensions. With the register in normal position (up), the flat sections contact the doweled ends of the stop screws (these screws are also used to secure the carry unit). This provides an upward limit for the register to keep the register intermediate gears in proper vertical relationship with the selector.

Eccentric bushings...located at both ends of the upper guide rod of the register unit ...provide a means of adjusting the relationship between the register positioning cams and the top rollers on the end plates when the register is in its normal (up) position and contacting the stop screws. This is the position that the register is in when its intermediate gears are rotated at high speed by the selector.

Register Eccentric Adjustment

Loosen lock screws slightly and position the high side of the eccentrics toward the front of the machine....This will provide a slight amount of play between the positioning cams and top rollers. This play can be felt by grasping the upper guide rod at the lock screws and moving the register up and down.

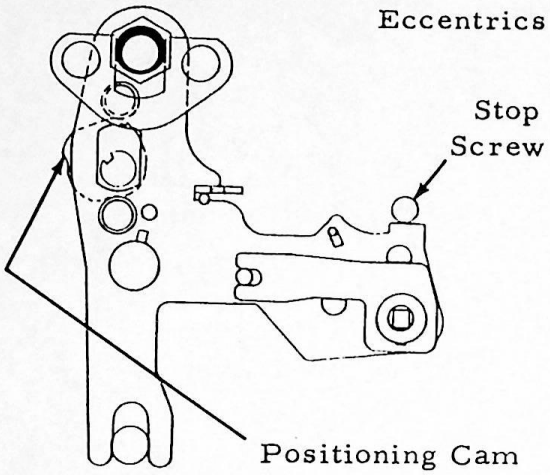
Eccentrics Too Far Forward
(Starting position for Adjustment)



NOTE: Vertical play will exist alternately at points indicated when moving the register up and down as described above.

Turning both eccentrics in a clockwise direction (as viewed from the right)... remove the play between the cams and rollers. NOTE: The eccentrics must be adjusted alike to avoid twisting the unit.

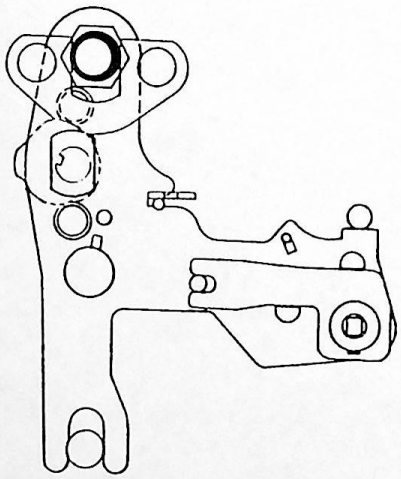
Eccentrics Properly Adjusted



NOTE: No vertical play....Register "locked" in rigid position against stop screws by positioning cams....No excessive "drag" on cams when raising register.

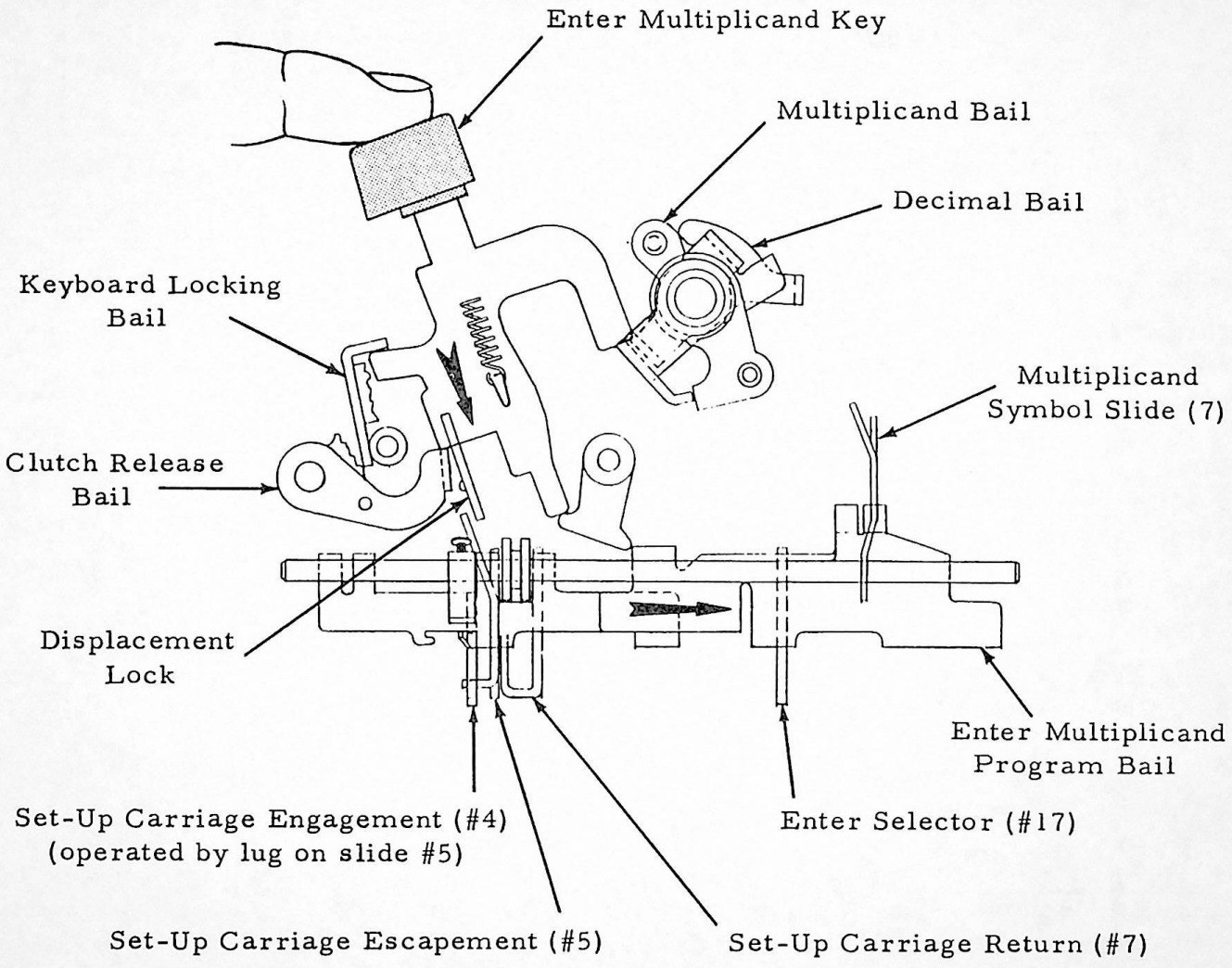
Check for over-adjustment...
With play removed, operate register engaging segment to move the register down and check that restoring spring moves register fully into its up position....

Eccentrics Too Far Rearward



NOTE: "Up" movement of register is limited by stop screws before high points of positioning cams move under top rollers....Register not "locked".

If eccentrics were turned too much the register will limit on stop screws before high points of positioning cams are under top rollers. This will cause either a heavy "drag" as the high point of the cams move under the rollers (Note: a light "drag" is permissable), or it will prevent the cams from turning far enough for their high points to get under the rollers. If the high points of the cams do not get under the rollers, the register will not be "locked" by the cams in its up position. Check for this by pushing down on the lock screws in the upper guide rod.


Enter Multiplicand Key
Multiplicand Bail
Decimal Bail
Keyboard Locking Bail
Multiplicand Symbol Slide (7)
Clutch Release Bail
Displacement Lock
Enter Multiplicand Program Bail
Set-Up Carriage Engagement (#4) (operated by lug on slide #5)
Enter Selector (#17)
Set-Up Carriage Escapement (#5)
Set-Up Carriage Return (#7)

When the enter multiplicand key is depressed, it operates the keyboard locking bail, clutch release bail, decimal bail * and multiplicand bail...and engages the displacement lock. The lower end of the enter multiplicand key pivots a bell crank which pushes the enter multiplicand program bail into engagement with the program feed plate.

> *Note:In the description of any function key operation where it is stated that the keystem operates the decimal bail...it is assumed that the decimal bail had not been operated previously by depression of the decimal key during the numeral set-up. If the decimal key had been so depressed, then of course the decimal bail would already have been latched-up and the function key depression would not affect it.

NOTE: Since the enter multiplicand cycle and the first machine cycle of the division program are almost identical...the following text will apply to both.

Capacity Locks

Part of the following description deals with "Selector Capacity" and the locks which are provided to prevent operation of the machine when this capacity has been exceeded....We will refer to "Selector Capacity" when discussing either multiplicand or divisor capacity, since both of these factors are entered in the selector.

The selector has eleven setable gears and therefore its entry capacity is eleven.... However, since we have a variable decimal arrangement this capacity must be divided between whole numbers and decimals. These capacities may be expressed as follows:

> The Whole Number capacity of the selector is eleven...less the setting of the right decimal knob.
>
> The Decimal capacity of the selector corresponds to the setting of the right decimal knob.

If the whole number capacity of the selector is exceeded by the set-up carriage entry, the selector whole number capacity lock mechanism will prevent depression of the enter multiplicand and division keys.

If the decimal capacity of the selector is exceeded by the entry in the set-up carriage, the selector decimal capacity lock mechanism will prevent release of the main cam shaft clutch when the enter multiplicand or division keys are depressed.

Therefore if the enter multiplicand and division keys cannot be depressed...it indicates to the operator that the whole number capacity has been exceeded. This whole number capacity lock is also called the "hard lock".

If the enter multiplicand and division keys can be depressed...but the machine does not respond...it indicates to the operator that the decimal capacity has been exceeded. This decimal capacity lock is also called the "soft lock".

NOTE: A similar hard and soft lock arrangement for whole numbers and decimals is provided for the three multiplication keys. Their entry capacity of ten is divided between whole numbers and decimals by the left decimal knob. This mechanism will be described under "multiplication key".

Previous Capacity

This model was originally designed with a selector entry capacity of twelve...instead of eleven...and several hundred machines have been manufactured with this capacity. The following description of selector capacity applies to these machines.

The selector has twelve setable gears and therefore its entry capacity is twelve.... However, since we have a variable decimal arrangement this capacity must be divided between whole numbers and decimals. These capacities may be expressed as follows:

The Whole Number capacity of the selector is twelve...less the setting of the right decimal knob.

The Decimal capacity of the selector corresponds to the setting of the right decimal knob (provided at least one decimal has been set at the knob).

The right decimal knob therefore controls the number of decimal places in entries to the selector from the set-up carriage.

There are two other things which should be noted concerning capacity before proceeding.... While we are primarily concerned with the capacity control mechanism, there are two overcapacity functions which can be performed within the limits of the capacity controls...and we should be aware of them.

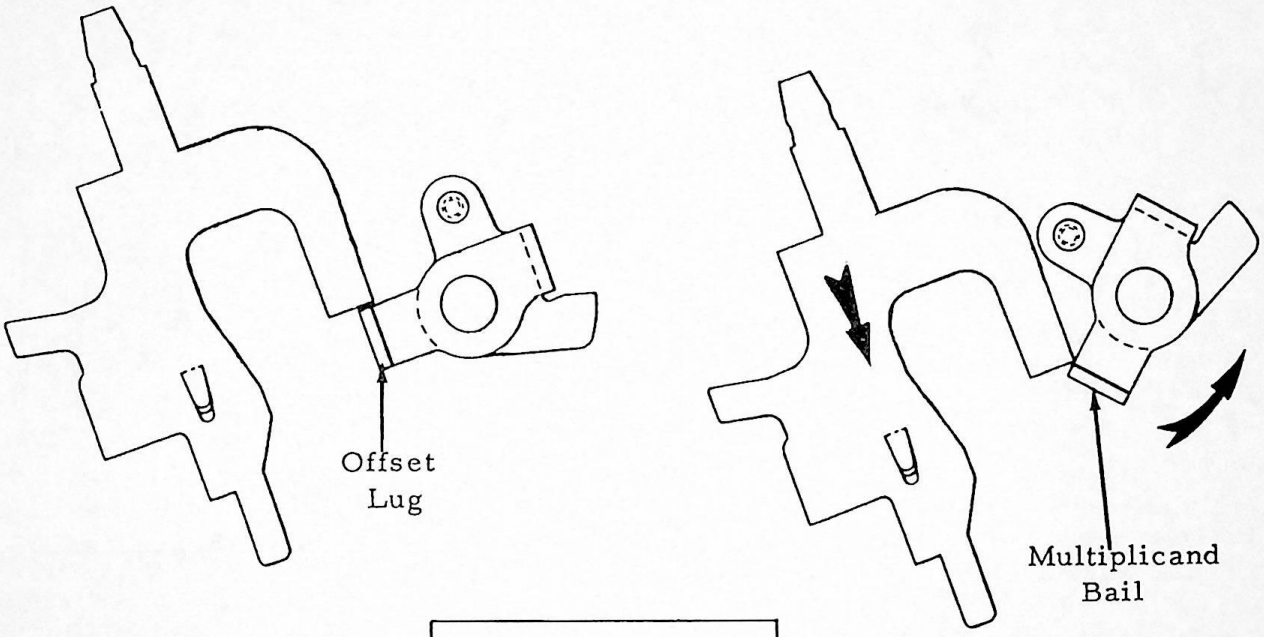
First, the mechanical capacity of the selector is twelve, the mechanical capacity of the multiplier/quotient gears is ten and the mechanical capacity of the register and accumulator is twenty-one. So...if we have a multiplicand of twelve digits and a multiplier of ten digits we could require a register and accumulator capacity of twenty-two...which we don't have. Therefore, the actual multiplicand capacity would be twelve only if nine or less multiplier digits were used. The actual multiplier capacity would be ten only if eleven or less multiplicand digits were used.

Secondly, while the mechanical capacity of the selector is twelve, a division alignment shift moves the twelfth column of the selector into alignment with the twenty-first column of the register. This twenty-first column register gear must be used to signal carry-overs out of the twentieth column...if it accepts direct entries from the selector the answer will be wrong. Therefore, while the mechanical capacity lock mechanism will permit division key depression with a divisor digit in the twelfth column of the selector...the actual capacity of a divisor is eleven.

The multiplicand bail is pivoted in a counter-clockwise direction (as viewed from the right) by the enter multiplicand keystem which contacts an offset lug on the right end of the bail.

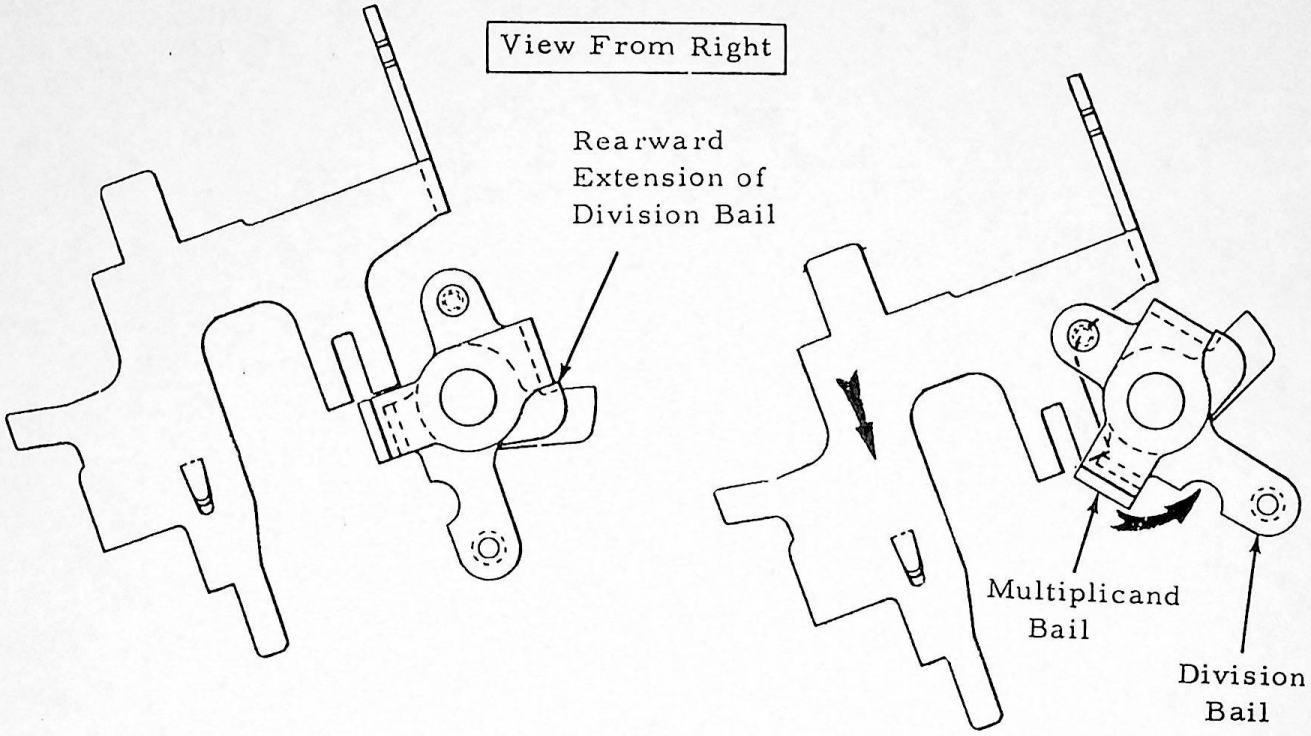
Enter Multiplicand Key (Normal Position)

Enter Multiplicand Key (Depressed Position)



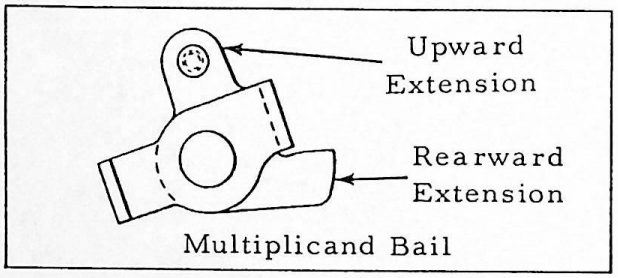
View From Right

The multiplicand bail is also pivoted in the same direction when the division key is depressed. . . . The division keystem pivots the division bail which has a rearward extension on its left end. This extension is located directly under the multiplicand bail and, as the division bail pivots, it causes the multiplicand bail to pivot with it.



Division Key (Normal Position)

Division Key (Depressed Position)

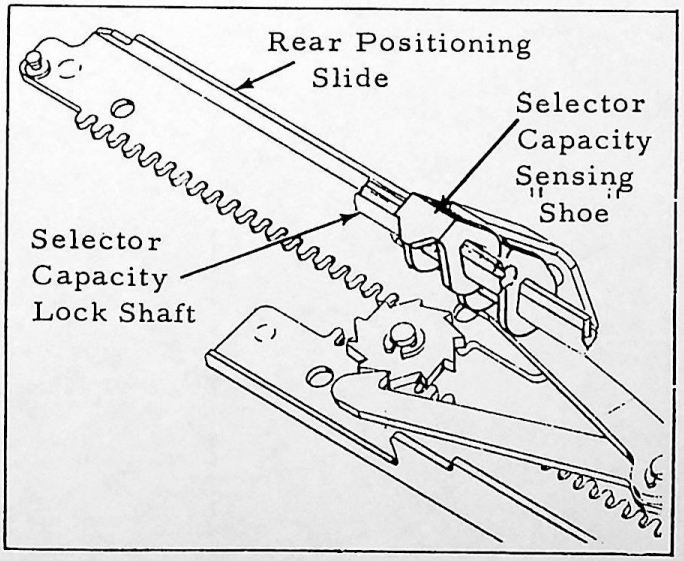


The left end of the multiplicand bail has two extensions, a rearward extension and an upward extension. . . .

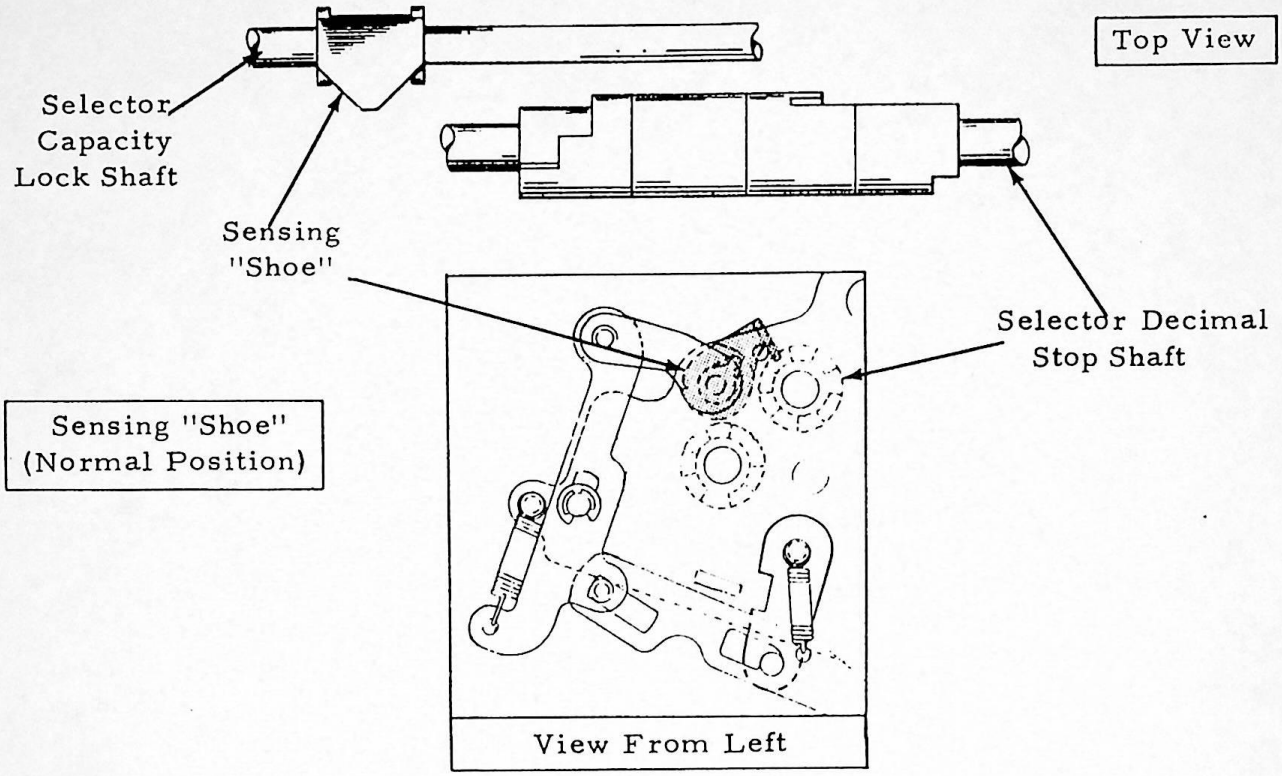
Selector Whole Number Capacity Lock (Hard Lock)

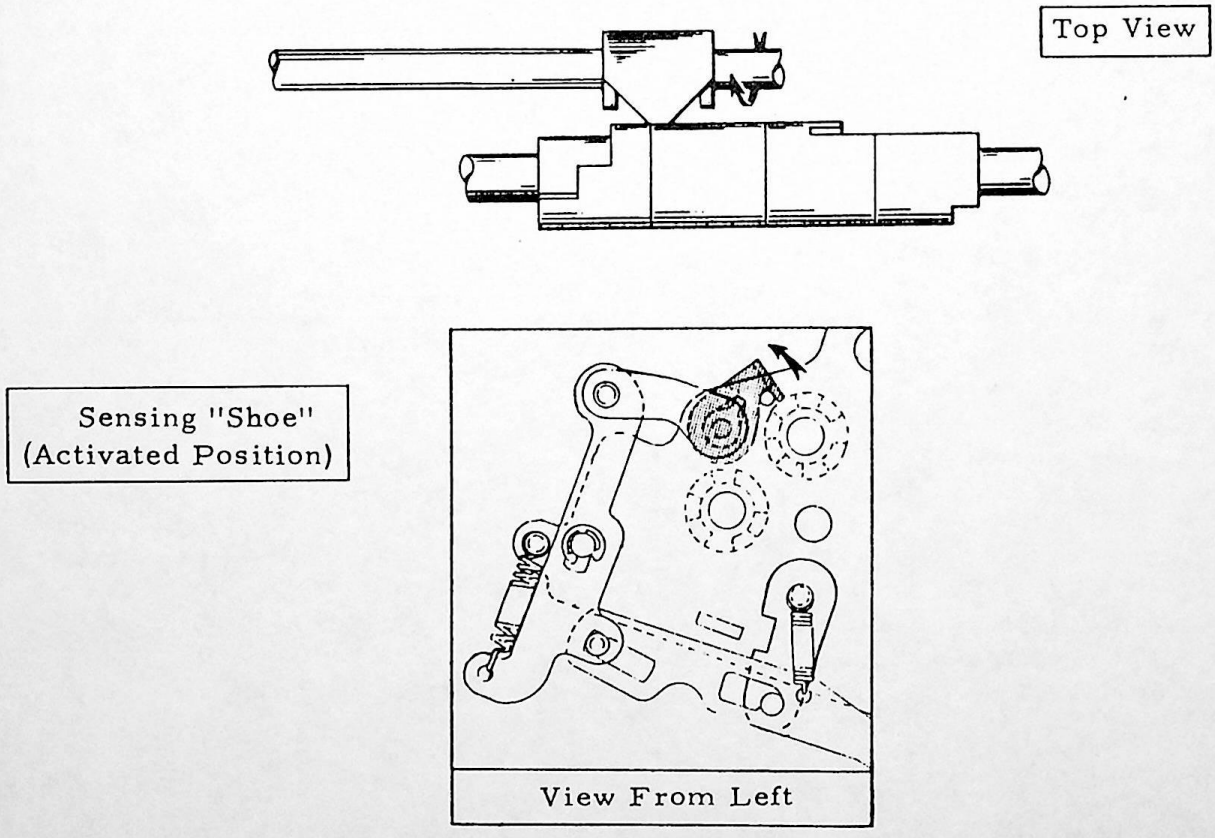
The rearward extension is provided to prevent depression of the enter multiplicand or division keys if the whole number capacity of the selector has been exceeded by the entry in the set-up carriage.

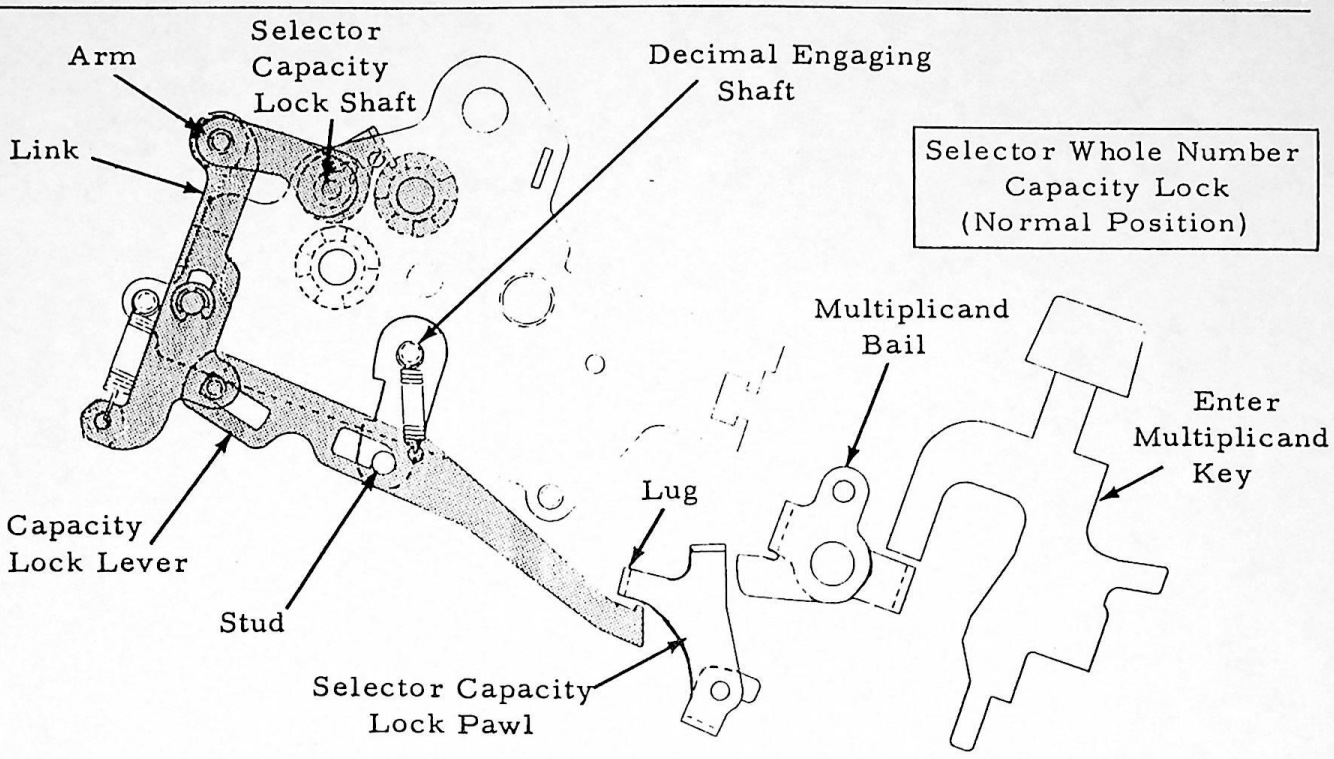
A capacity sensing "shoe" is keyed to the selector capacity lock shaft and slides laterally with the rear positioning slide for the set up carriage. (A similar arrangement is provided for capacity sensing of set-up carriage entries to the multiplier gears).



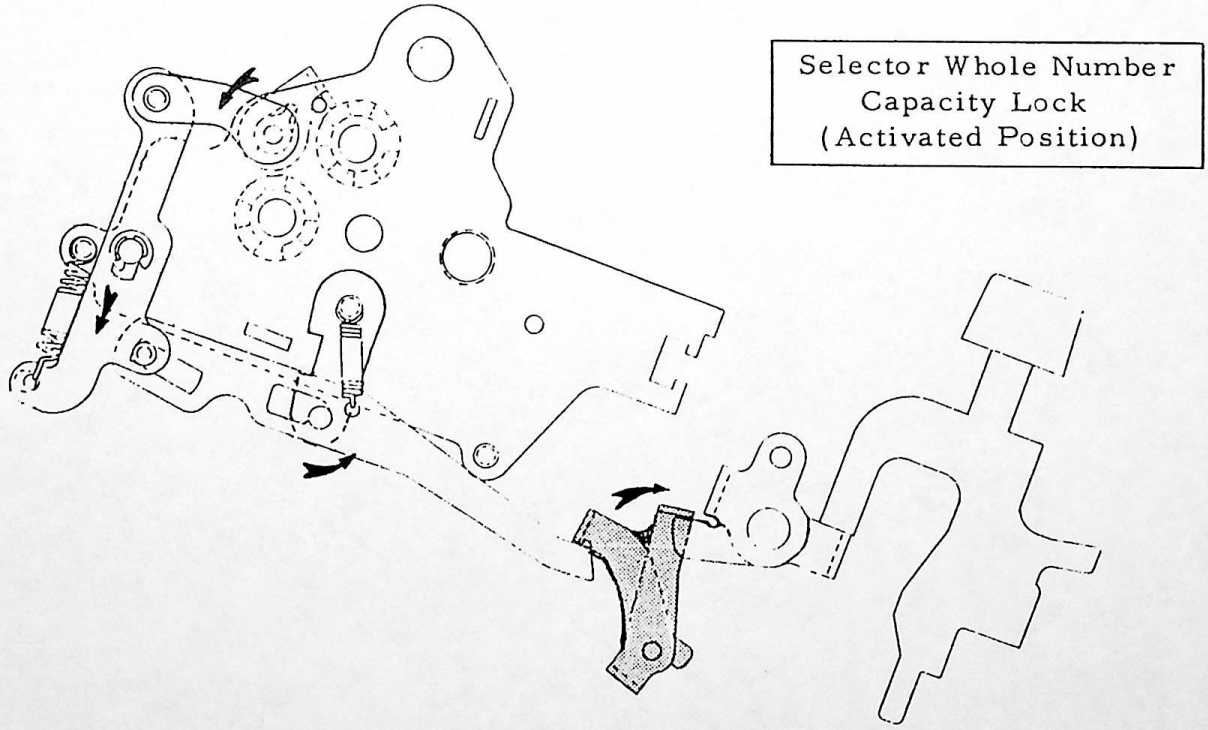
When the whole number capacity is exceeded, the "shoe" will be cammed counter-clockwise (as viewed from the left), by the appropriate stop on the selector decimal stop shaft. NOTE: This is the middle shaft of the three decimal stop shafts....
Ref: Pages IV-E-7and IV-E-8

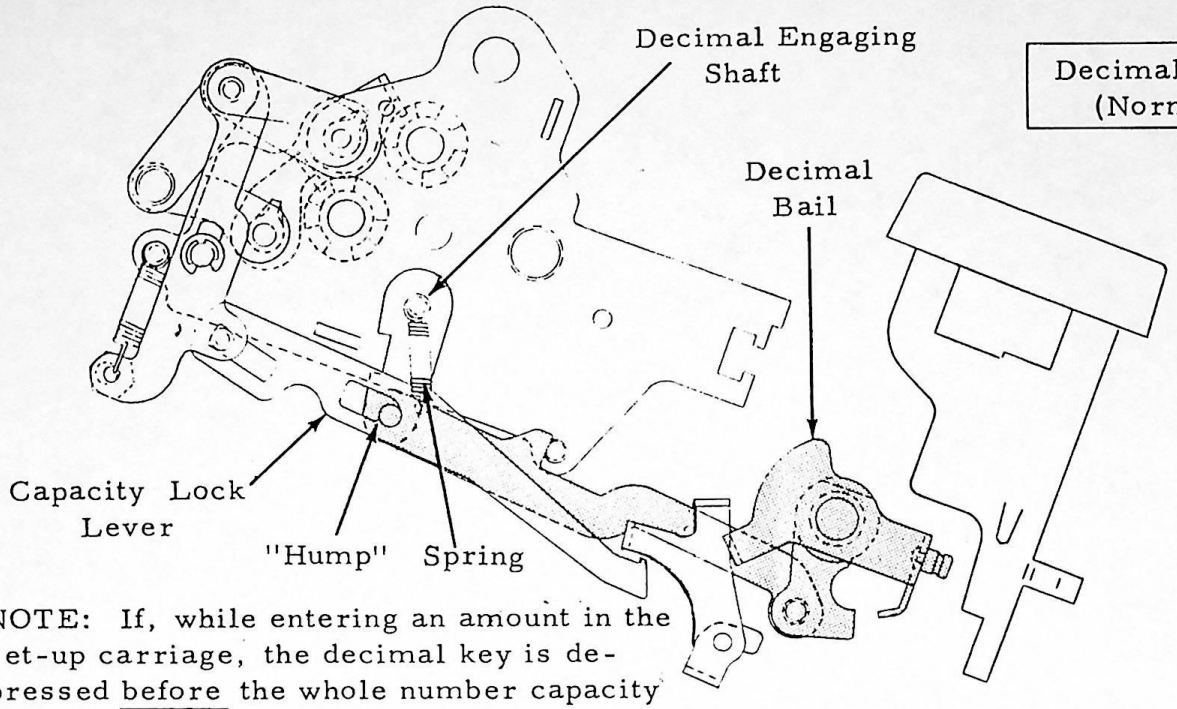




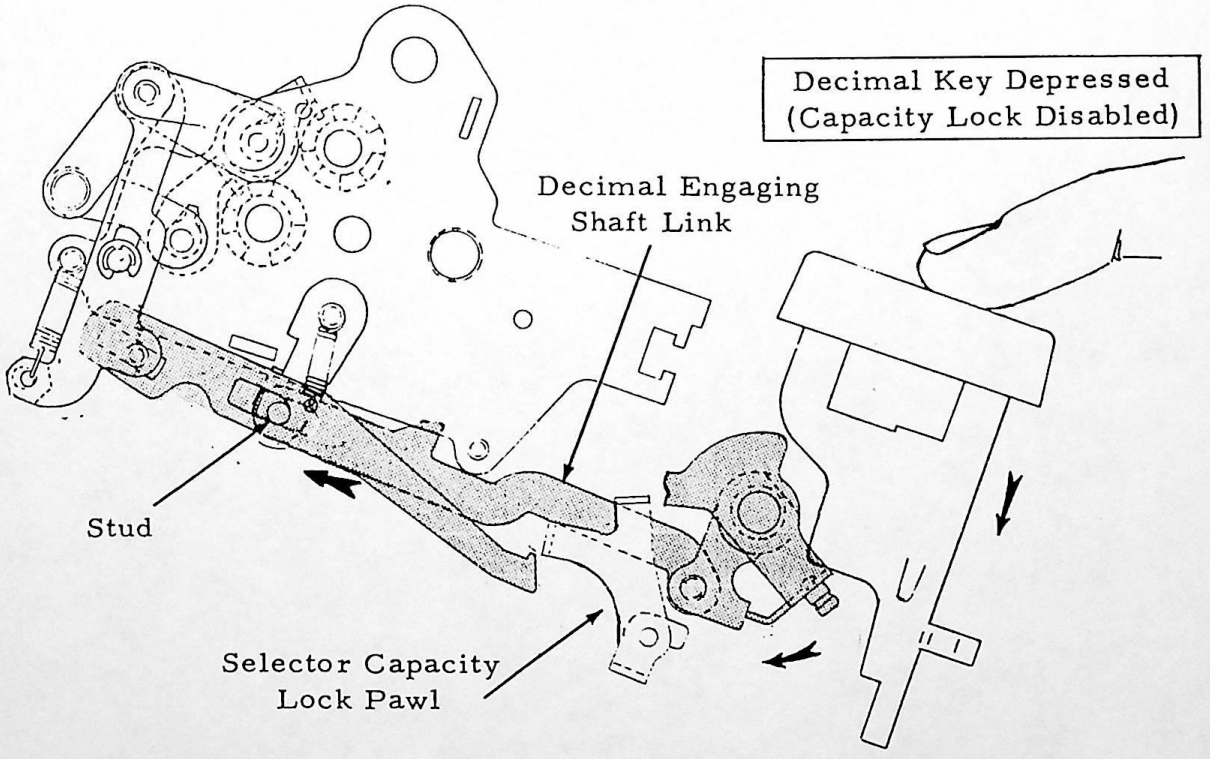


This movement of the "shoe" pivots the selector capacity lock shaft. The arm at the left end of the shaft pivots down, pushing the link of the capacity lock lever down with it. This causes the lever to pivot on the stud of the left arm on the decimal engaging shaft... raising the forward end of the lever. The forward end of the lever engages the rear offset lug of the selector capacity lock pawl... pivoting the pawl so that its upper offset lug positions over the rearward extension of the multiplicand bail. In this position the lock pawl will prevent the multiplicand bail from pivoting and thereby prevent the depression of the enter multiplicand and division keys.

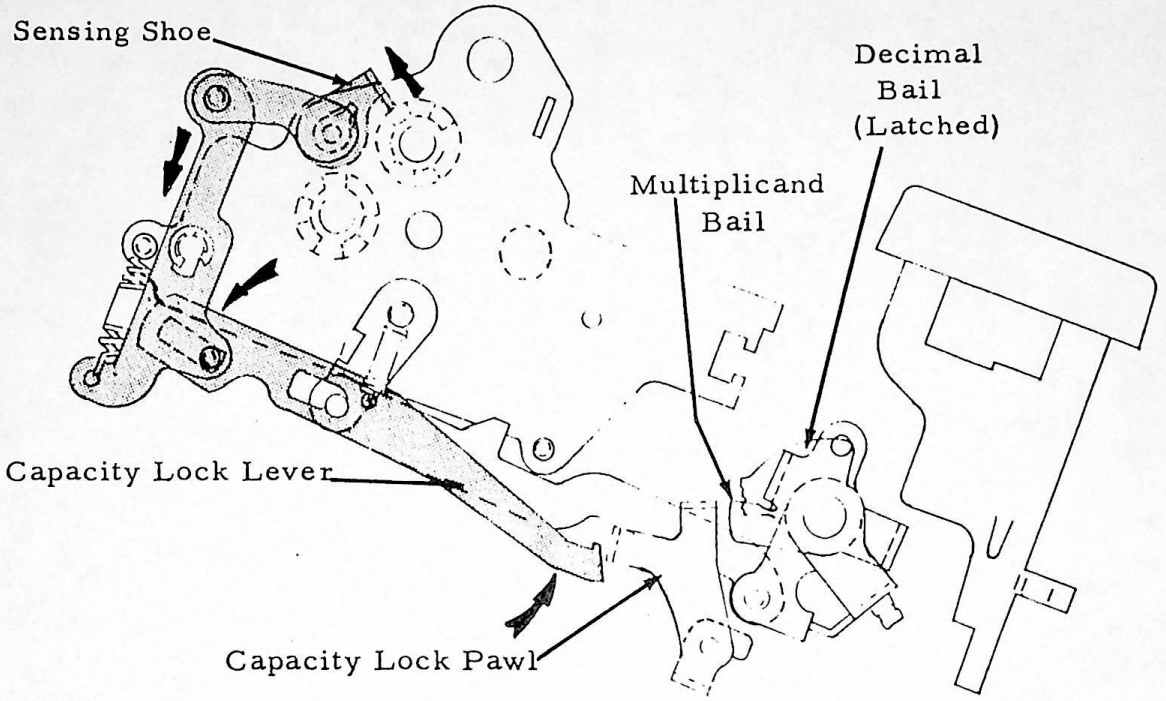




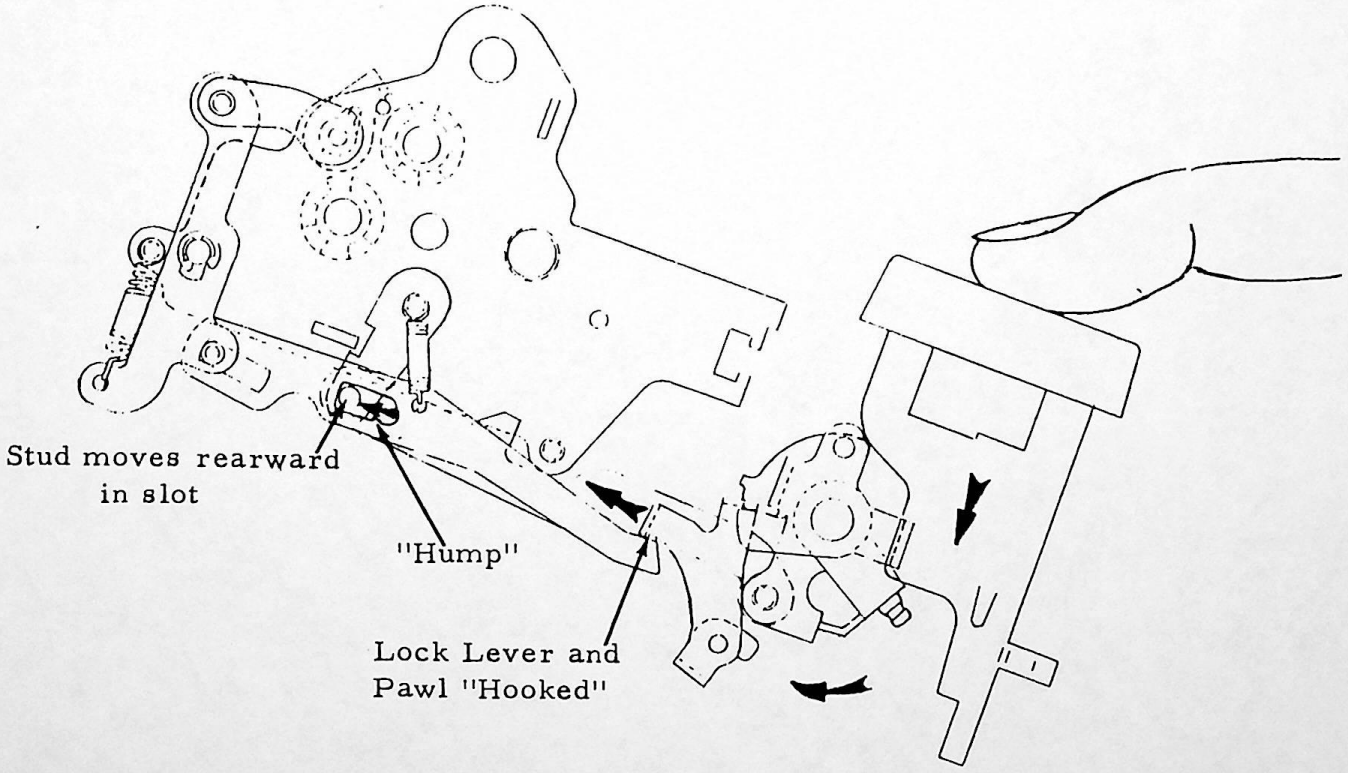
NOTE: If, while entering an amount in the set-up carriage, the decimal key is depressed before the whole number capacity is exceeded, and subsequent decimal digits are entered, this lock will be disabled. Depression of the decimal key pivots the decimal bail which pushes the decimal engaging shaft link rearward. The link is attached to the same stud of the left arm on the decimal engaging shaft that the capacity lock lever pivots on. The rearward movement of the link pushes the stud to the rear (pivoting the decimal engaging shaft). The capacity lock lever, when not activated, is held upward by a spring so that the stud engages the lower edge of the slot in the lever. This edge has a "hump" form which the stud engages and the stud then carries the lever to the rear with it... moving the forward end of the lever out from under the rear offset lug of the selector capacity lock pawl.



Thereafter, if the capacity lock lever is pivoted thru the action of the sensing "shoe", it will not engage the selector capacity lock pawl...so the enter multiplicand and division keys could still be depressed.

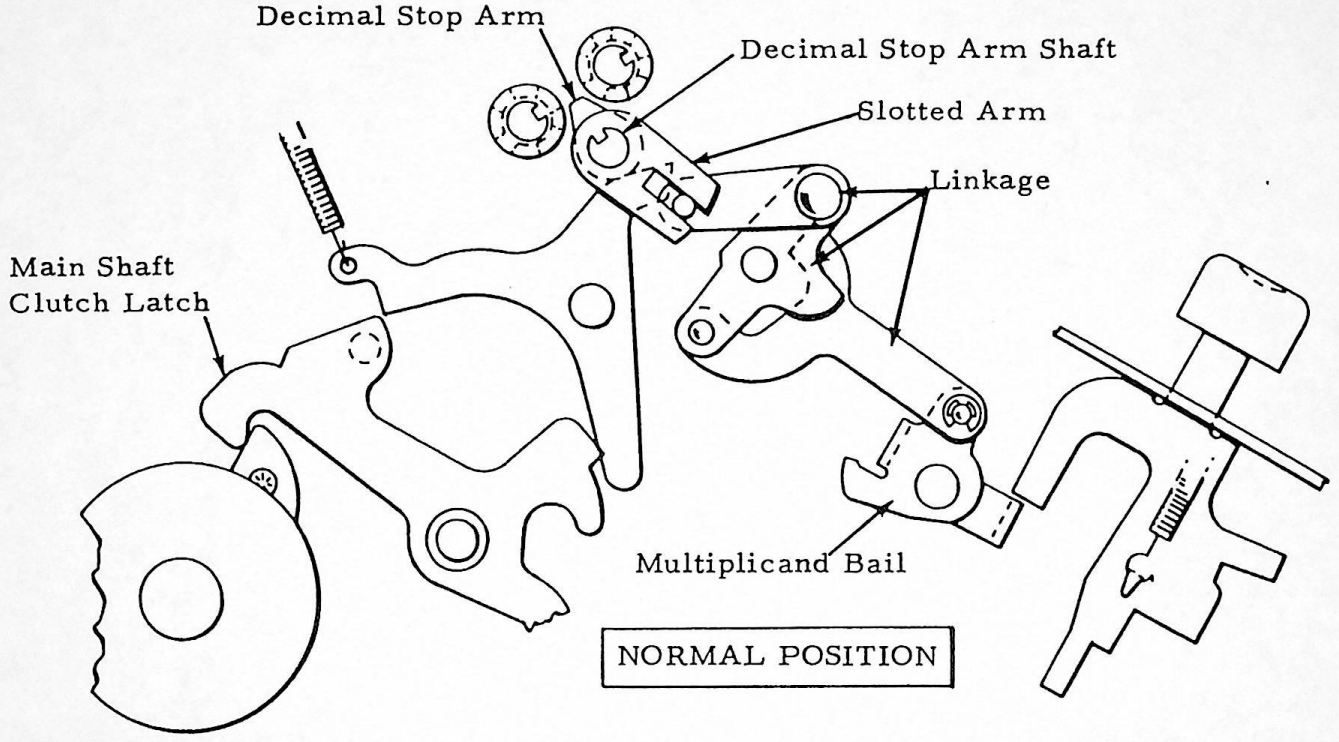


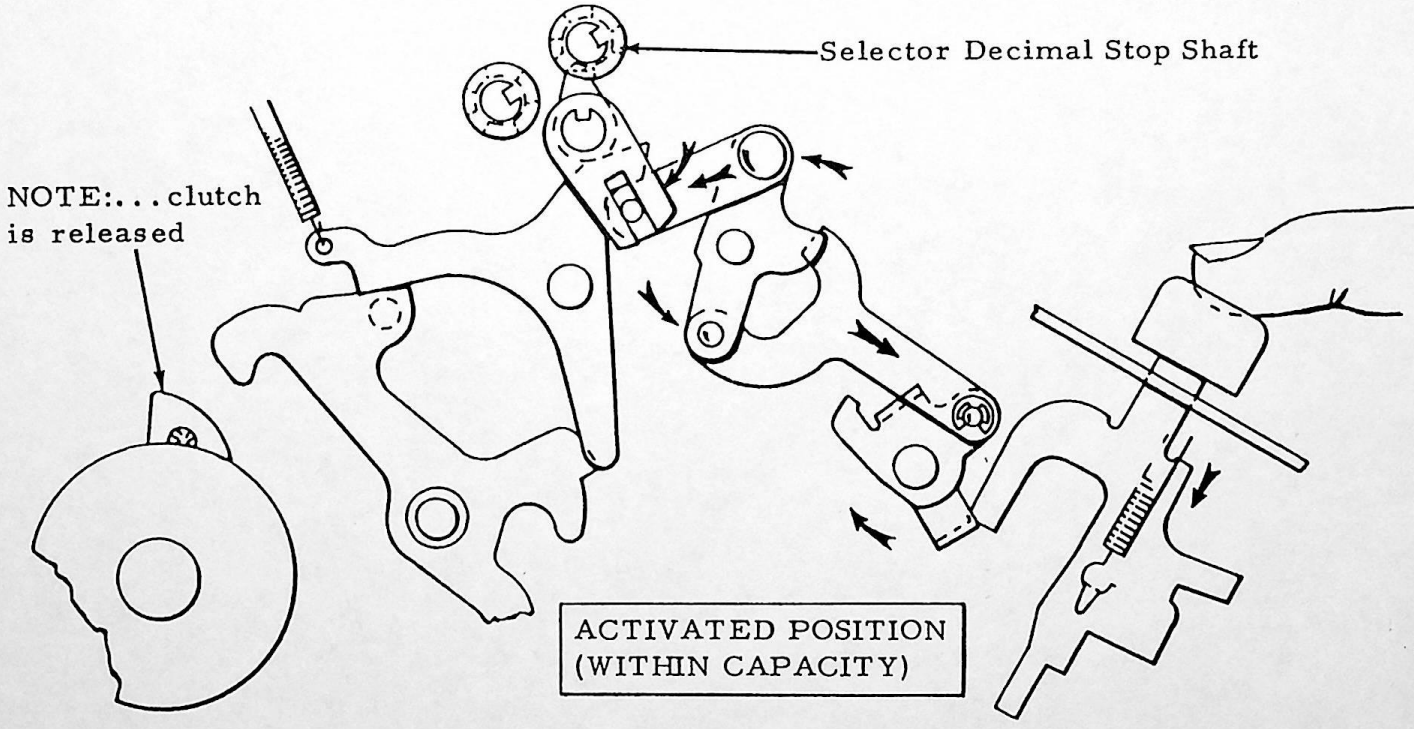
If, however, while entering an amount in the set-up carriage, the decimal key is depressed after the whole number capacity is exceeded, the lock will not be disabled....The forward end of the capacity lock lever will have "hooked" the rear offset lug of the selector capacity lock pawl. Then the stud of the left arm on the decimal engaging shaft would cam over the "hump" on the bottom edge of the slot and the stud would not carry the lever with it as it moved rearward.



Selector Decimal Capacity Lock(Soft Lock)

The upper extension on the left end of the multiplicand bail operates the linkage which pivots the decimal stop arm shaft. If the selector decimal capacity has not been exceeded, the decimal stop arm is pivoted up to align with the stops of the selector decimal stop shaft...where it will stop the escapement of the set-up carriage at the selected decimal position (provided a total of at least three decimals have been selected).





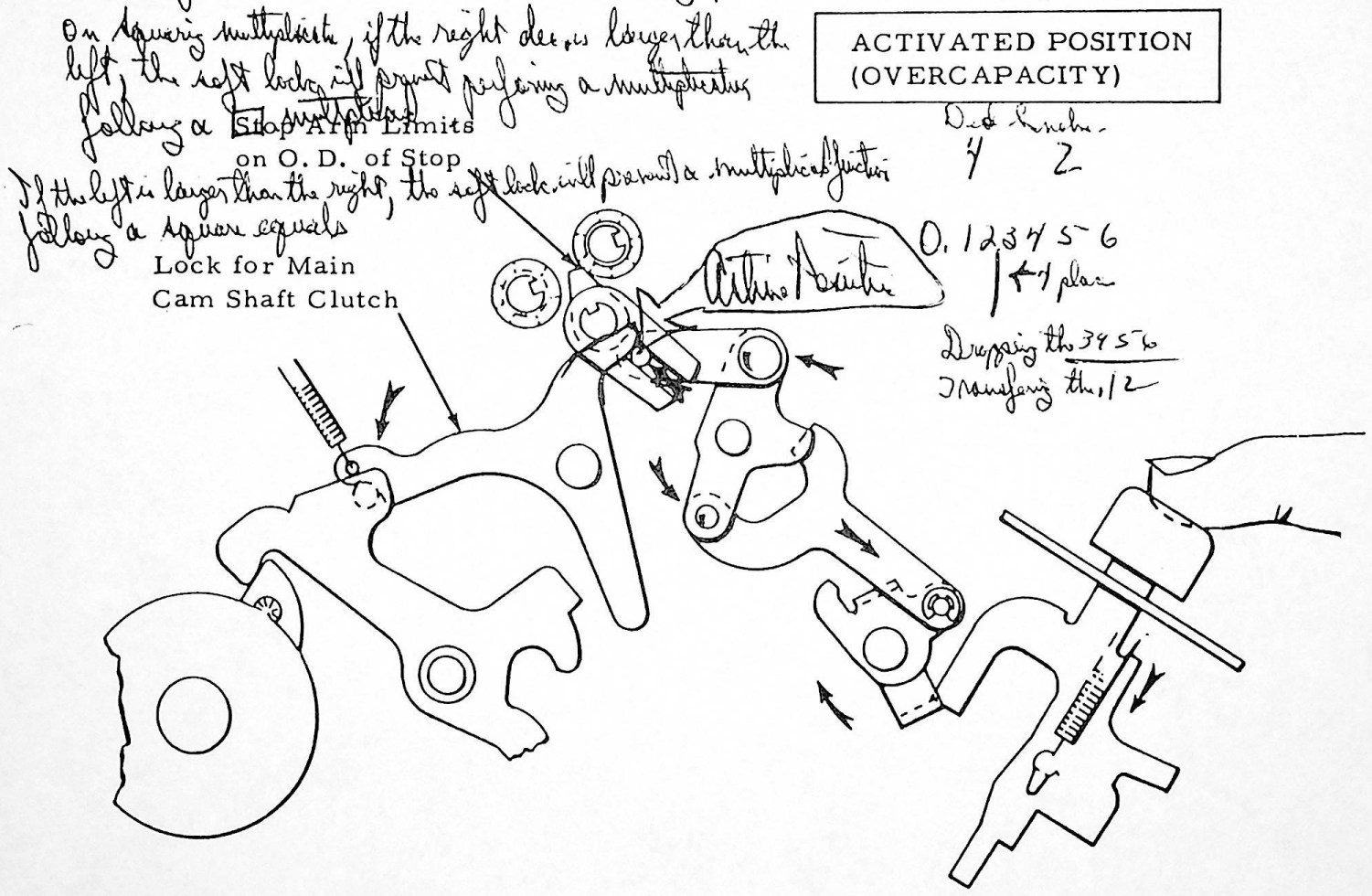
If the selector decimal capacity has been exceeded, by the amount entered in the set-up carriage after depression of the decimal key, the decimal stop arm will limit on the outside diameter of the stops... preventing the stop arm shaft from pivoting. While this limiting of the stop arm shaft does not prevent the further depression of the key, it does cause the linkage to yield in such a manner that it pivots the lock for the main cam shaft clutch latch into engagement with the stud of the clutch latch... preventing the release of the clutch.

On transfer multiplicand the left dec control knob will control the number of places the selector will shift to the left before it receives the transfer.

The right control knob controls the number of places that will be transferred to the selector.

On squaring multiplicand, if the right dec is longer than the left, the left lock will prevent performing a multiplication following a square equals

If the left is longer than the right, the right lock will prevent a multiplication following a square equals



Adjustment

With mechanism in neutral position, loosen set screws in slotted arm on left end of decimal stop arm shaft and position shaft so that decimal stop arm has equal clearance at outside diameter of stops on both stop shafts... as shown in "normal position" drawing on preceding page. Tighten screws.

Program Feed

As the machine starts its cycle and the program feed plate is driven to the left, the enter multiplicand program bail activates the following program slides:

Set-Up Carriage Escapement (#5),
which activates the Set-Up Carriage Engagement (#4)

Set-Up Carriage Return (#7)

Enter Selector (#17)

The enter multiplicand program bail also pushes the multiplicand symbol slide (7) to its full right position where its stop lug will stop the rearward travel of the right symbol rack for printing the multiplicand (X) symbol.

The functions of program slides #4, #5 and #7 have been described in detail previously. To summarize:

a. Program slide #4 activates drive arm for engaging set-up carriage with racks.

b. Program slide #5 escapes set-up carriage or operates alternate hold-up release arm...depending on decimal setting.

c. Program slide #7 positions non-repeat bail for carriage return and shifts decimal bail to the right.

As the enter selector program slide (#17) moves to the left, it moves the forward end of the selector set-up clutch latch to the left with it.... There are three possible variations in this function, depending upon the positioning of certain mechanism, that can occur at this point.

They can be identified as:

1. Normal Program

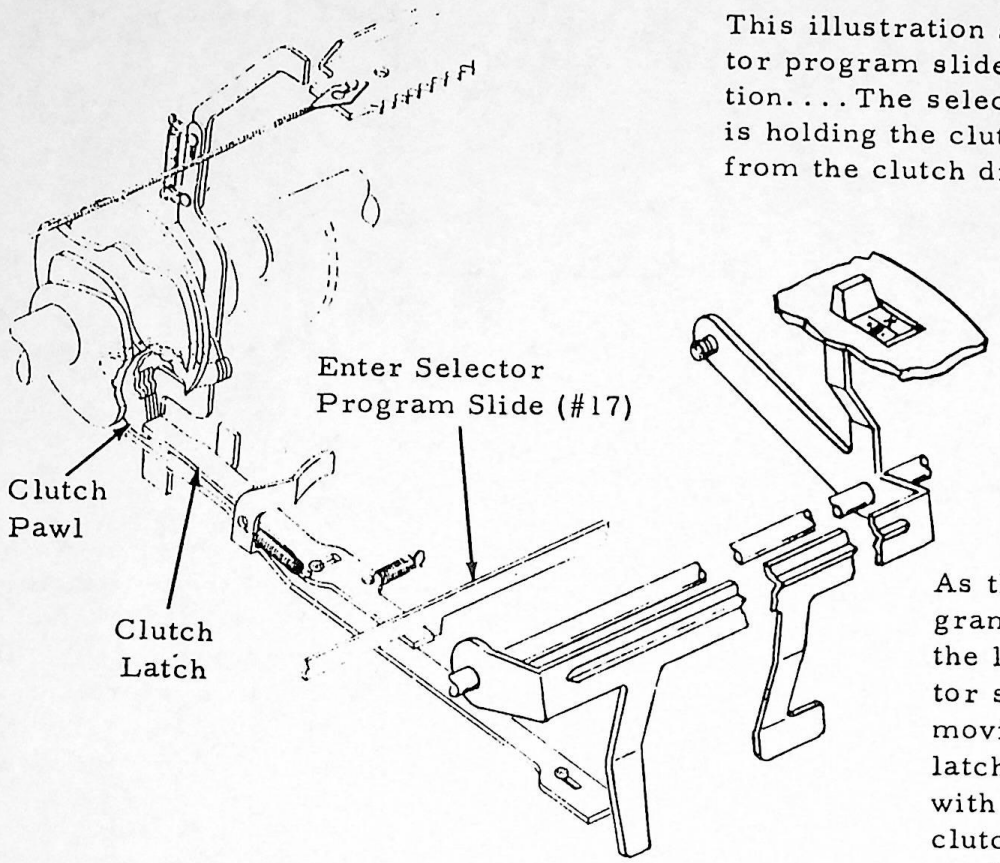
2. Constant Program

3. Quotient Transfer Program

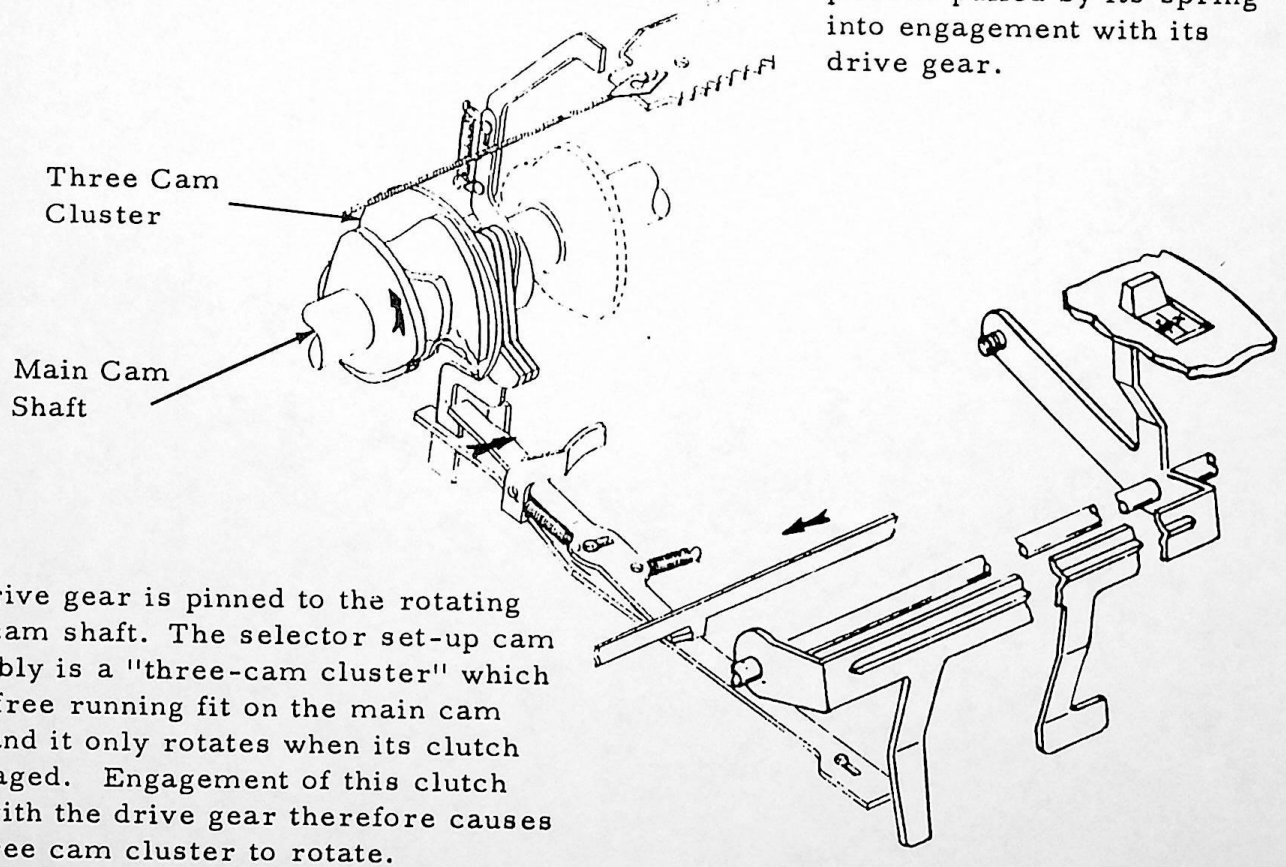
At this time we are only concerned with the normal program.... The variations related to the other two programs will be covered at the end of the normal program description.

Normal Program.... This is the function which will take place if the Constant Divisor/Quotient Transfer lever is in constant divisor position and an amount has been entered in the set-up carriage.

This illustration shows the enter selector program slide (#17) in neutral position.... The selector set-up clutch latch is holding the clutch pawl disengaged from the clutch drive gear.



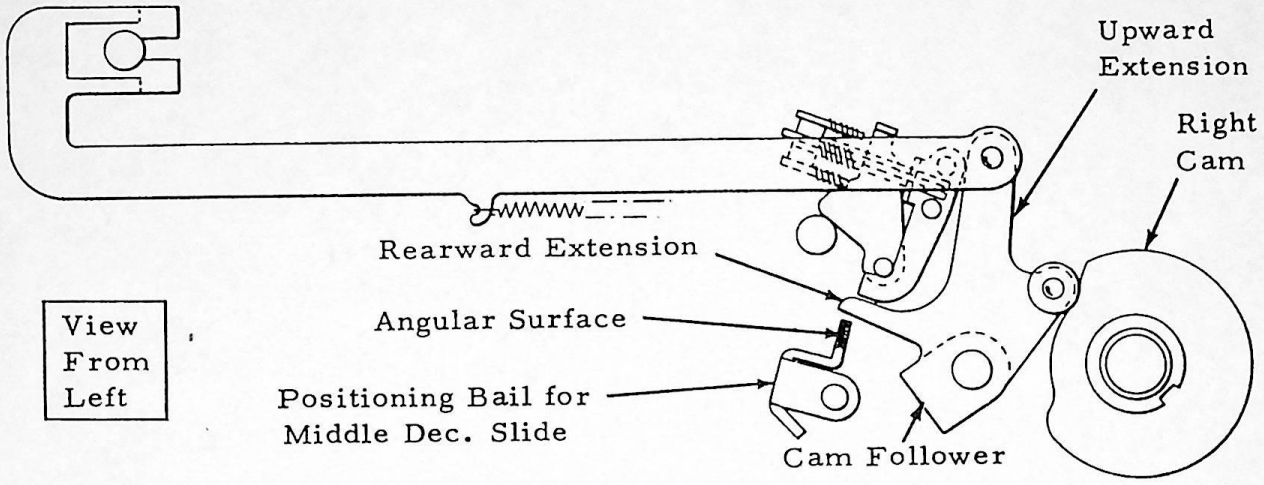
As the enter selector program slide (#17) moves to the left it pivots the selector set-up clutch latch... moving the rear end of the latch out of engagement with the selector set-up clutch pawl. The clutch pawl is pulled by its spring into engagement with its drive gear.



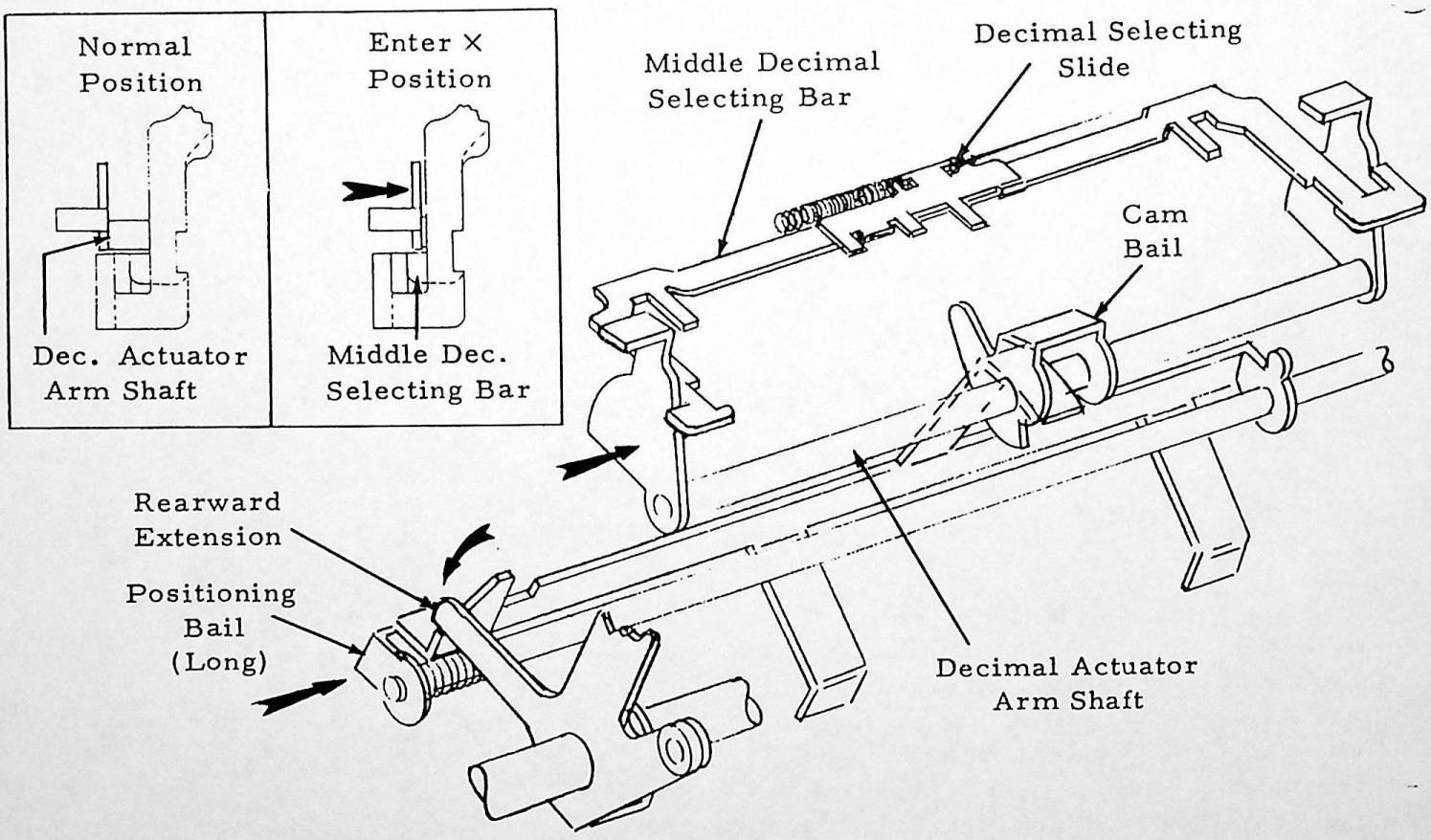
The drive gear is pinned to the rotating main cam shaft. The selector set-up cam assembly is a "three-cam cluster" which has a free running fit on the main cam shaft and it only rotates when its clutch is engaged. Engagement of this clutch pawl with the drive gear therefore causes the three cam cluster to rotate.

Selector Set-Up

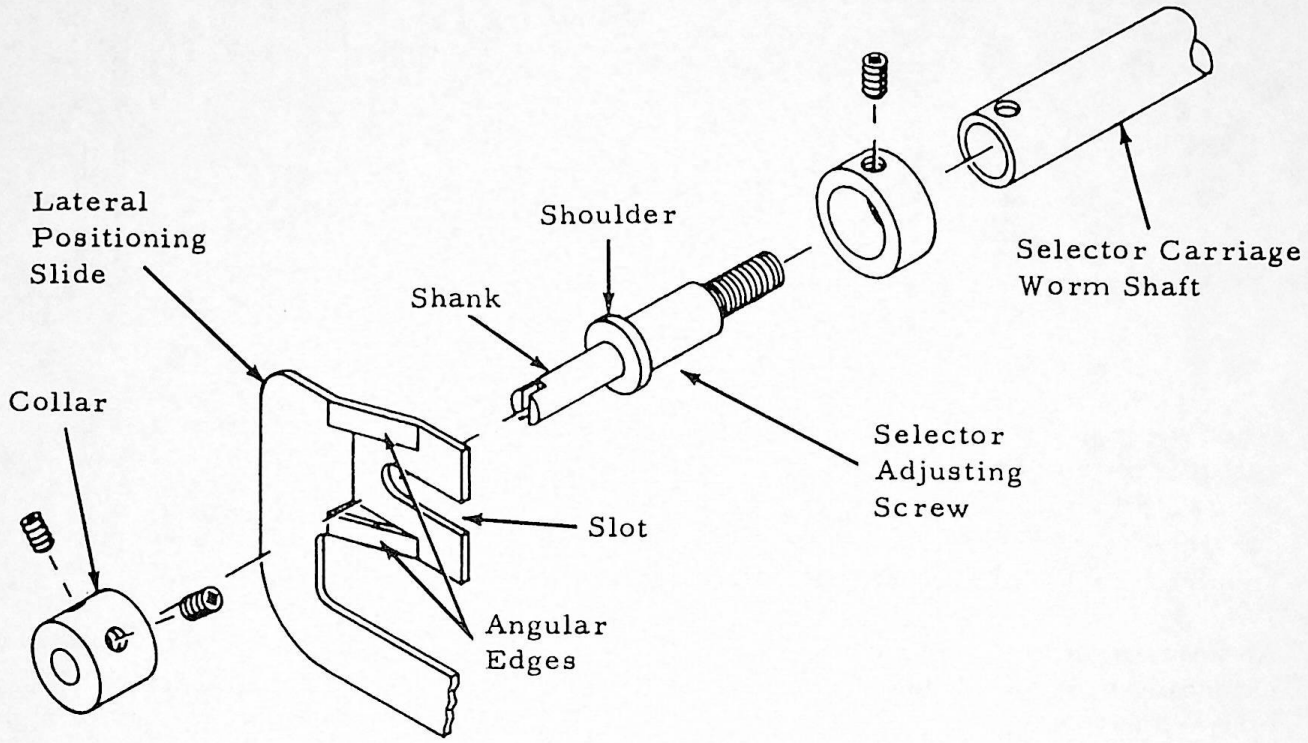
The right cam on this cluster pivots its cam follower. The cam follower has two extensions...a rearward extension and an upward extension.



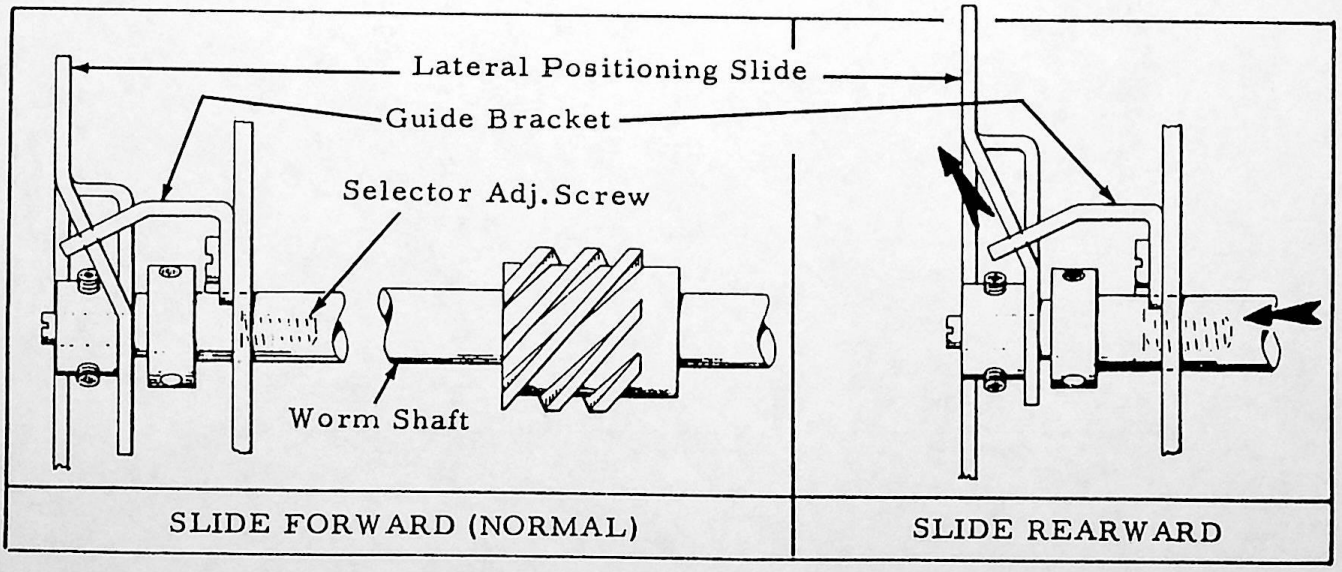
The rearward extension contacts an angular surface on the left end of the positioning bail (long bail) for the middle decimal selecting bar...camming the bail to the right. An upward extending form on this bail is positioned between the arms of the cam bail on the decimal actuator arm shaft. The decimal actuator arm shaft is therefore moved to the right with the positioning bail so that the actuator arms are aligned to select the middle decimal selecting bar. (The position of the decimal selecting slide on the middle decimal selecting bar is controlled by the right decimal knob).



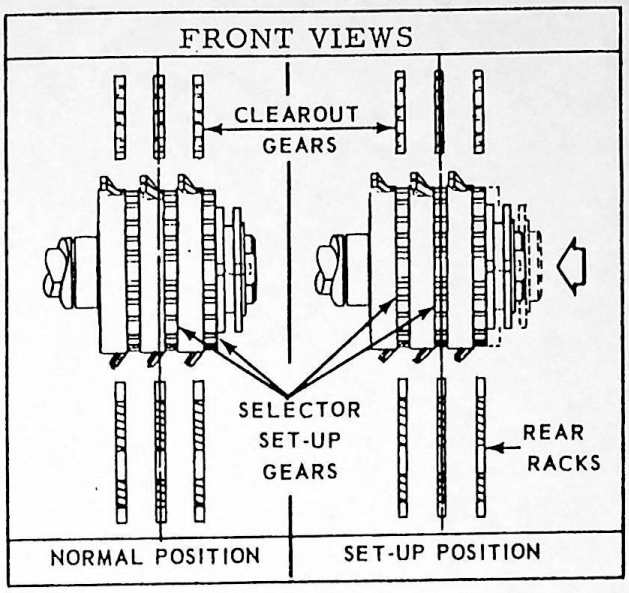
The upward extension of the right cam follower pushes the lateral positioning slide for selector set-up to the rear. A slot at the rear of this slide rides on a shank extension of the selector lateral position adjusting screw and a collar, set screwed to the shank, holds the slide against a shoulder on the screw. The collar is adjusted for minimum side play of the slide while maintaining free front to rear movement.



The top and bottom edges of the rear operating end of the lateral positioning slide are formed at an angle. These edges ride in the slots of a guide bracket which is formed at the same angle. Therefore, when the lateral positioning slide is pushed to the rear by its cam follower its rear end is moved to the left by the angular forming of its edges.... This left movement of the slide pulls the selector position adjusting screw to the left. The screw... secured in the left end of the selector carriage worm shaft... pulls the worm shaft, selector carriage and selector to the left.

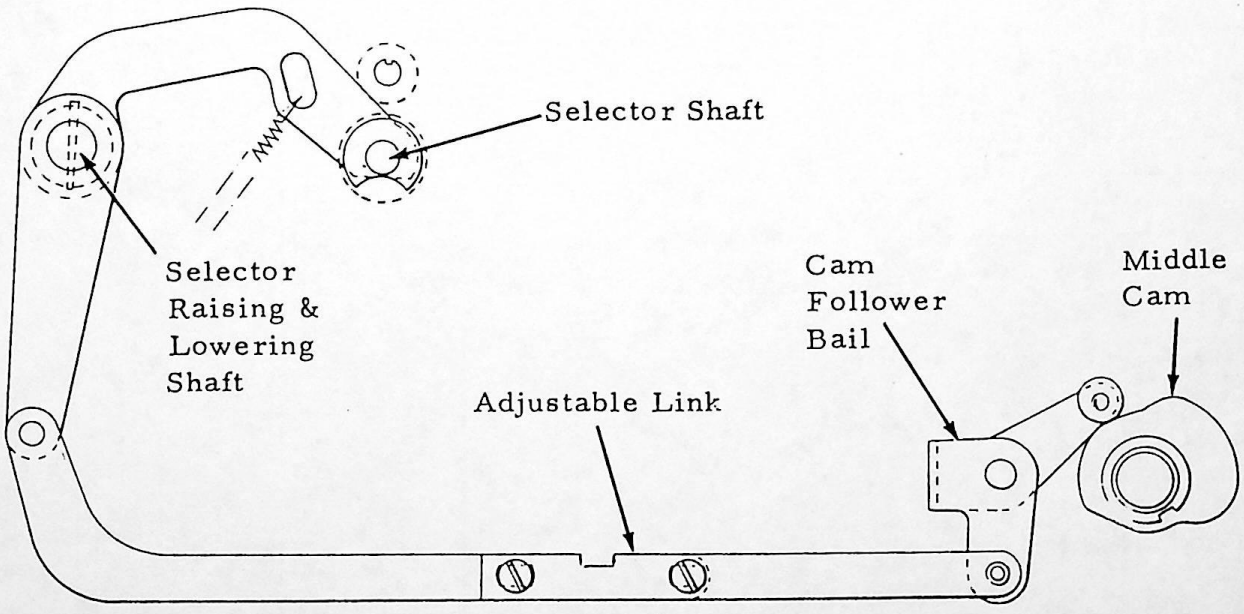


This movement to the left (approximately 1/16") aligns the selector set-up gears of the setable selector gears with the clearout gears and racks.

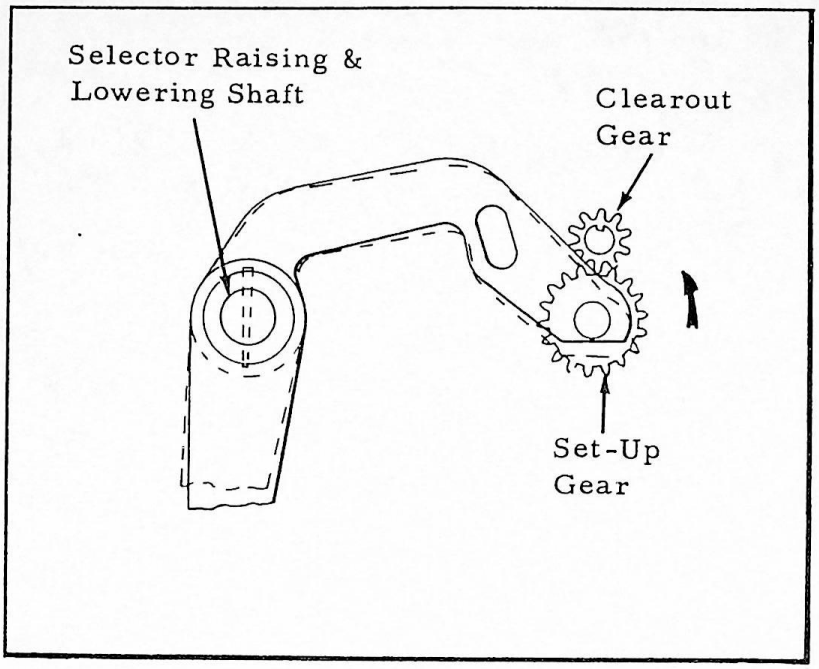


When the right cam of the three cam cluster has aligned the set-up gears of the selector with the clearout gears and racks, the middle cam of the three cam cluster pivots its cam follower. This cam follower is a heavy bail... the right end extension carries the cam follower roller and a lower extension on its left end supports a shoulder stud which projects out to the left side of the machine.

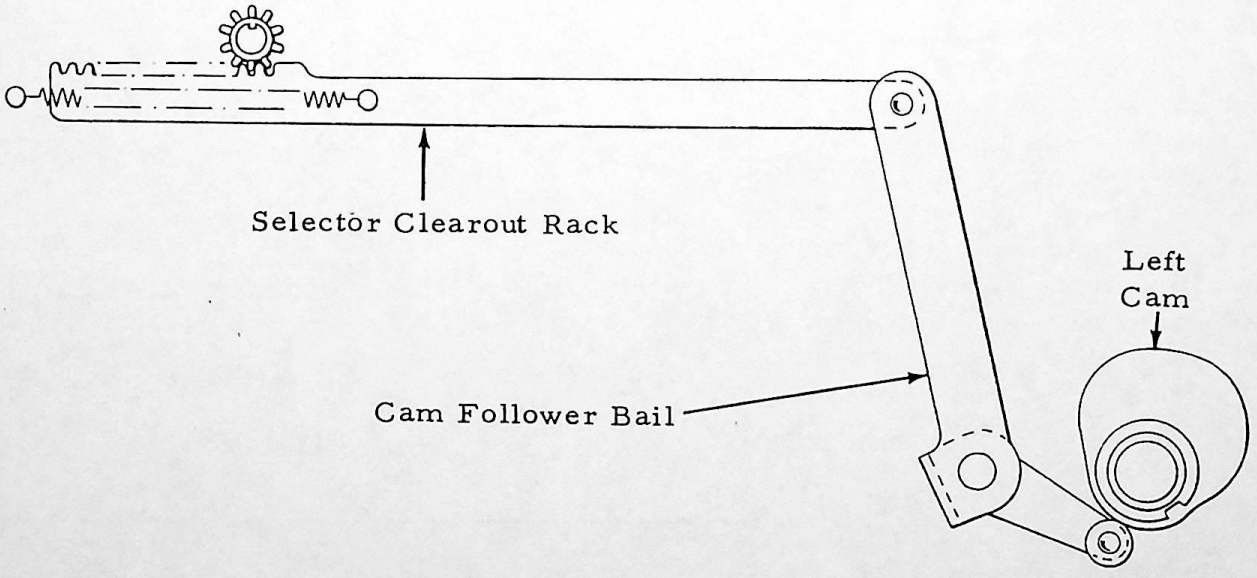
An adjustable link connects the shoulder stud of the cam follower bail to a downward extending arm on the left end of the selector raising and lowering shaft.... Two forward extending arms on this shaft (one near the left end and one near the right end) support the selector shaft.



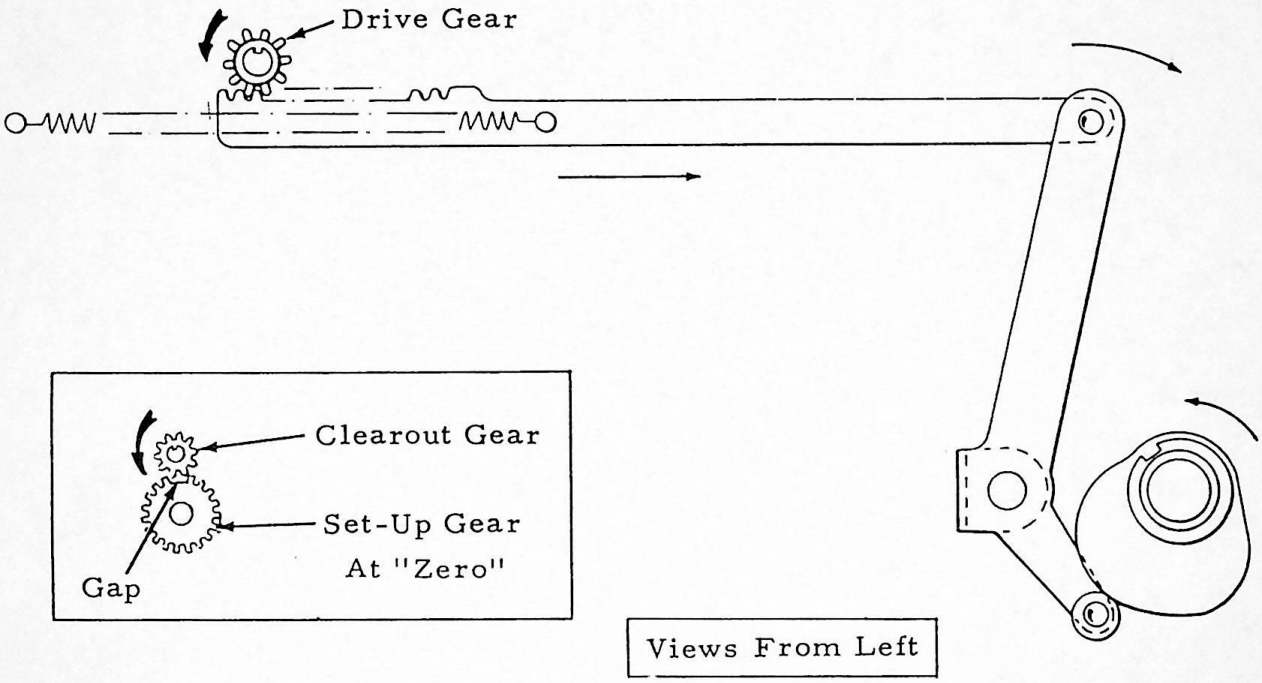
Therefore, as the middle cam follower pivots, its stud pulls the adjustable link forward which pivots the selector raising and lowering shaft raising the selector shaft. This moves the selector up so that its set-up gears mesh with the clearout gears.



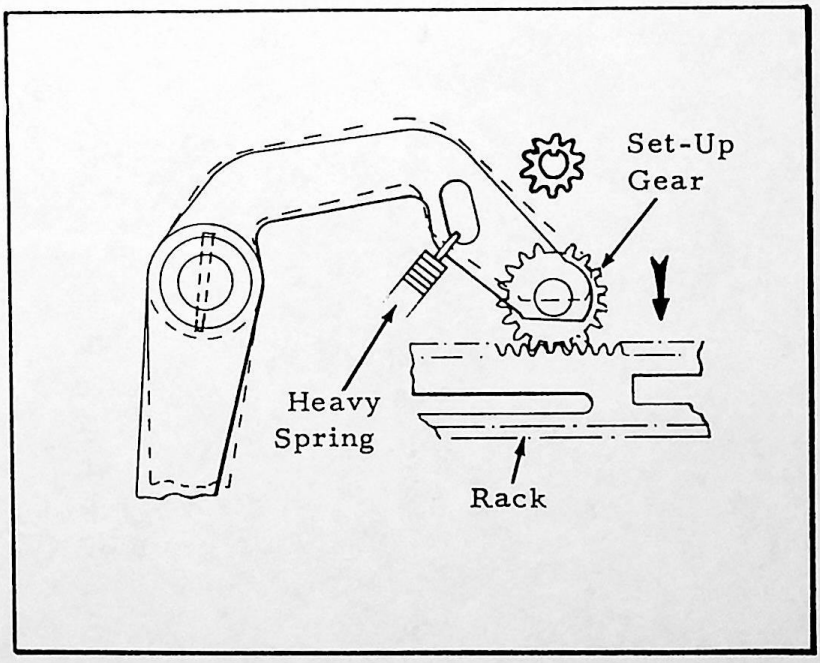
The third cam (left cam) of the three cam cluster now pivots its cam follower. This cam follower is also a bail...the right end extension carries the cam follower roller and an upward extension on its left end connects to the selector clearout rack.



Pivoting of this cam follower pulls the selector clearout rack forward. The teeth of the clearout rack are in mesh with the drive gear for the selector clearout shaft and the forward movement of the rack rotates the clearout shaft. As the clearout shaft rotates, its clearout gears turn the selector set-up gears to their "zero" position. Note: When a selector set-up gear reaches its "zero" position, a gap in the set-up gear teeth presents itself to the clearout gear and any further rotation of the clearout gear does not affect the set-up gear.

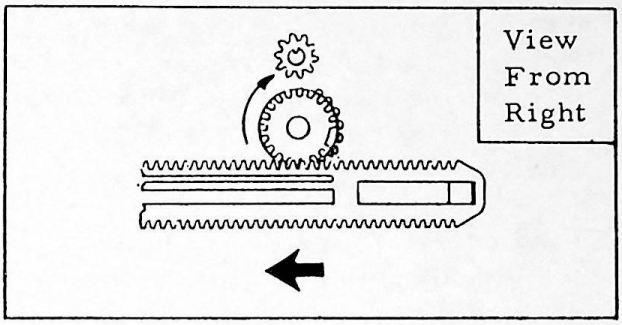


When the selector clearout rack reaches its full forward position the middle cam follower moves into the low section of its cam and the selector shaft is pulled down by the heavy spring on the left support arm of the selector raising and lowering shaft. The downward movement of the selector moves its set-up gears out of mesh with the clearout gears and into mesh with the racks. This occurs at the halfway point in the cycle... after the racks representing the entry from the set-up carriage have moved to the rear... the entry printed... the racks aligned... and while the rack restoring cam dwells with the rack restoring bar in its rearward position.



As the selector is being moved down into mesh with the racks, the total/sub-total cam follower is pivoted by its spring as the cam follower moves into the low section of the total lobe of the cam. This restores the #2 operating slide to the rear... which releases the set-up carriage from engagement with the racks. NOTE: This last paragraph refers to the regular program function.... For the squaring key function with the enter multiplicand key refer to Page IV-H-2.

With the selector set-up gears in mesh with the racks, the rack restoring cam starts to drive the rack restoring bar forward. This forward restoring of the racks enters the amount in the selector.



While the racks are being restored, the cam follower for the left cam of the three cam cluster moves into the low section of the cam as the selector clearout rack is pulled rearward by its spring to its normal position.

When the racks reach their full forward position the middle cam of the three cam cluster pivots its cam follower... raising the selector up out of mesh with the racks to its normal vertical position.

With the selector raised to its normal vertical position, the cam follower for the right cam of the three cam cluster moves into the low section of the cam as the return spring pulls the lateral positioning slide for selector set-up forward. This moves the selector worm shaft, selector carriage and selector back to the right to their normal lateral position.

This movement of the cam follower for the right cam of the three cam cluster also releases the positioning bail for the middle decimal selecting slide. The positioning bail is returned to its normal left position by its spring.

This occurs near the end of the cycle as the program cam starts to return the program feed plate to the right. The return of the feed plate to the right is the end of the cycle on enter multiplicand functions.... For the continuation of the division function from this point, refer to Page V-G-4.

Program Variations

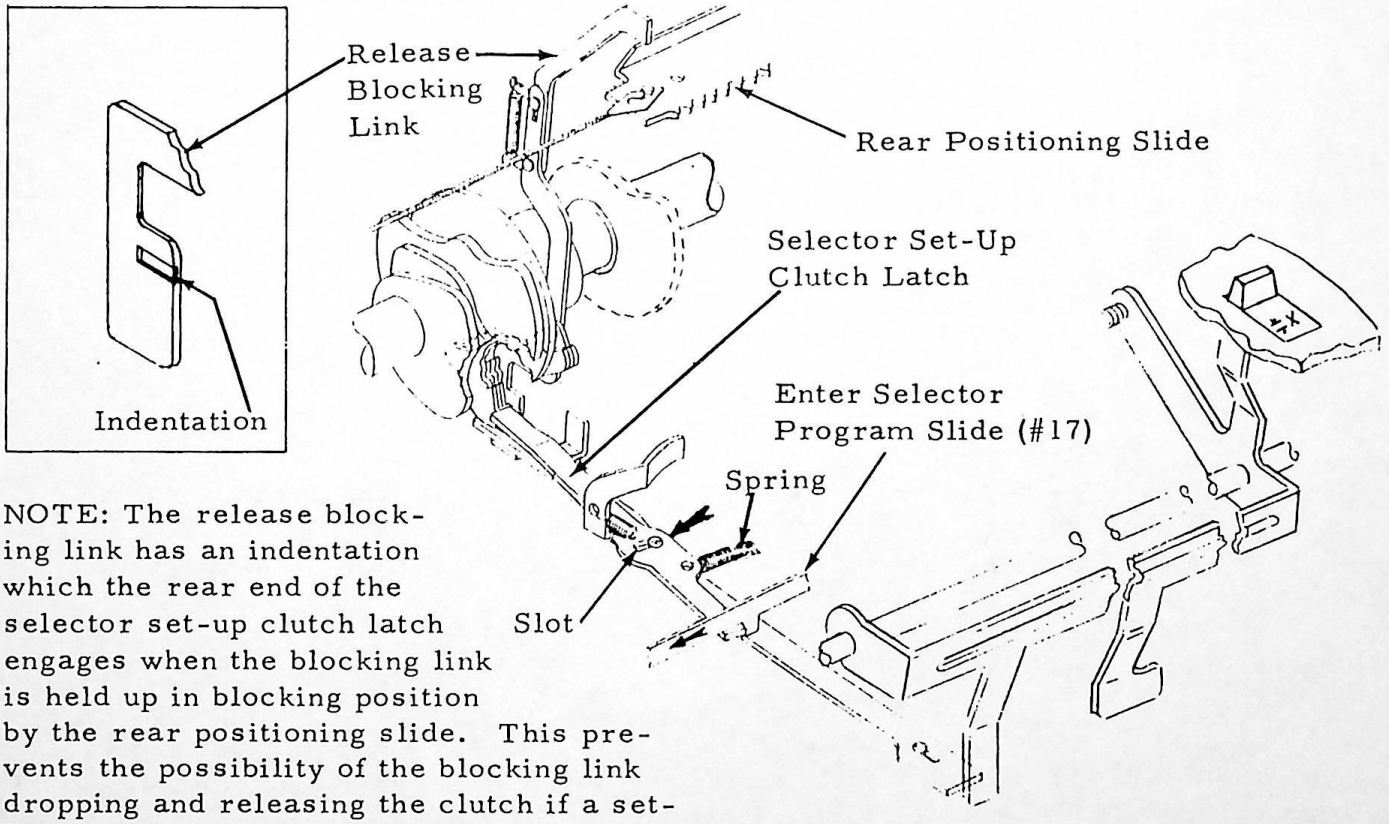
At the start of this description of the "Normal Program" it was noted that two variations other than the normal program were possible. These were the "Constant Program" and the "Quotient Transfer Program".

Constant Program.... This is the function which will take place if the Constant Divisor/Quotient Transfer lever is in constant divisor position and no entry is made in the set-up carriage.

Movement of the enter selector program slide (#17) to the left moves the forward end of the selector set-up clutch latch to the left.... The rearward end of the selector set-up clutch latch starts to pivot but immediately contacts the lower end of the release blocking link.

NOTE: This blocking link is always cammed upward by the rear positioning slide for the set-up carriage when the carriage is moved into "home" position. As soon as an entry is made in the set-up carriage ("Normal Program") the rear positioning slide moves to the right...its camming surface moves out from under a lug on the upper end of the release blocking link and the link is pulled down (by gravity) so that the cut-out notch in its lower end is in sidewise alignment with the selector set-up clutch latch. Therefore, on a normal program, the latch can pivot into this notch and release the clutch pawl.

When the rearward end of the selector set-up clutch latch contacts the lower end of the release blocking link it stops pivoting. The forward end of the latch must continue the movement to the left since it is being driven by the program slide. Therefore, the center of the latch will also be moved to the left. This center point of the latch has an elongated slot which fits over a stud in the bottom plate of the program unit. The latch is normally held to the right by a spring so that the left end of its slot is held against the stud. In this position the stud serves as the pivot point when the rear end of the latch is not blocked.... With the rear end blocked, the slot permits the center of the latch to be moved to the left and the spring yields.



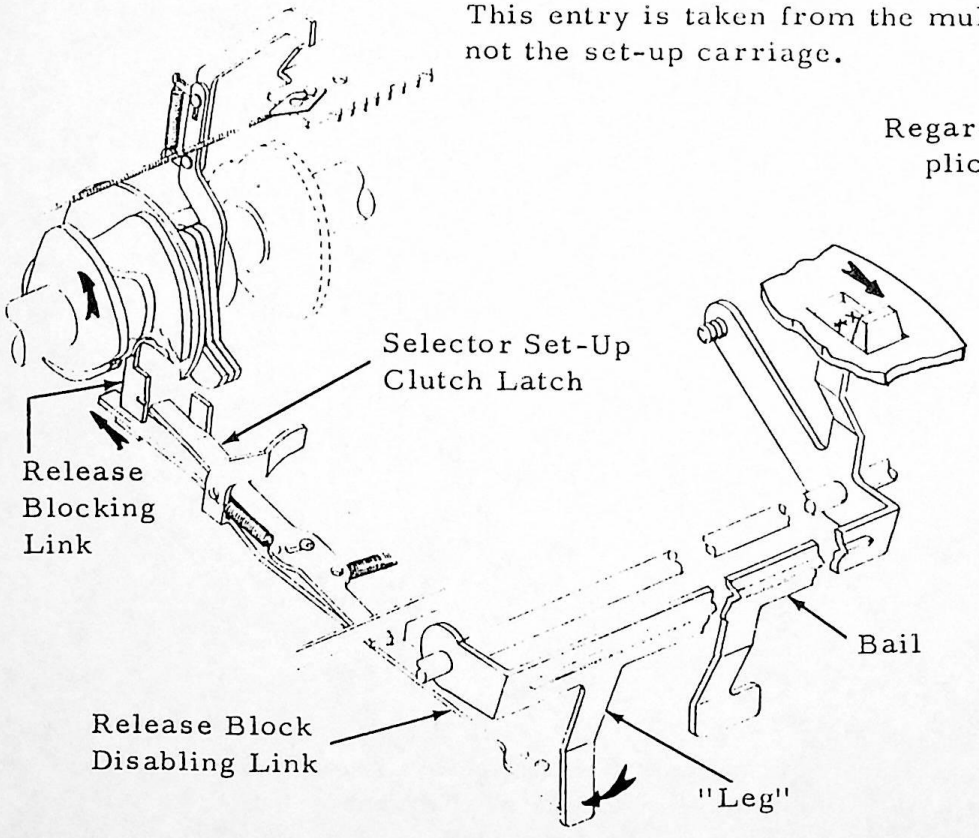
NOTE: The release blocking link has an indentation which the rear end of the selector set-up clutch latch engages when the blocking link is held up in blocking position by the rear positioning slide. This prevents the possibility of the blocking link dropping and releasing the clutch if a set-up carriage escapement takes place.... The set-up carriage would escape if three or more decimals were set.

Because the rear end of the selector set-up clutch latch is prevented from releasing the clutch pawl, the clutch is not activated... the selector is not cleared... and no entry is made.

This arrangement is provided to permit the use of a constant divisor. Of course, there would be no reason to depress the enter multiplicand key without an entry in the set-up carriage. If, however, the enter multiplicand key is depressed accidentally without an entry in the set-up carriage, this feature is considered valuable in that it would prevent the clearing of a constant from the selector.

Quotient Transfer Program.... This is the function which will take place if the Constant Divisor/Quotient Transfer lever is in quotient transfer position.

A mechanism has been provided to disable the "constant feature" (release blocking link described above) when the Constant Divisor/Quotient Transfer lever is in quotient transfer position. This is necessary to permit the selector set-up clutch to be activated on a quotient transfer operation when a second entry to the selector is made on the quotient cycle. This entry is taken from the multiplier/quotient gears... not the set-up carriage.

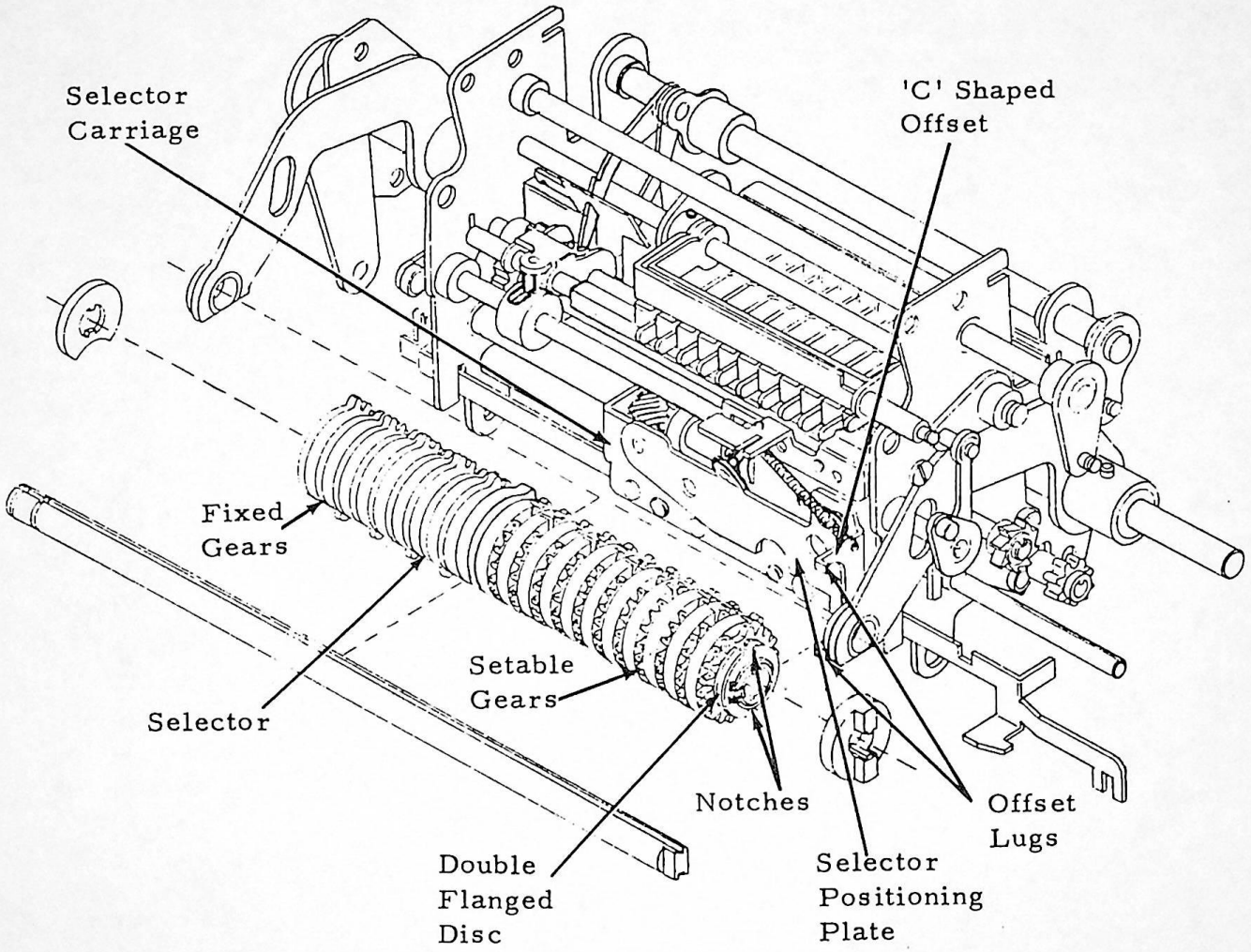


Regarding the enter multiplicand cycle and the first cycle of the division program, it should be noted that depression of either of these keys with the lever in quotient transfer position and no entry in the set-up carriage will cause the selector to be cleared. With an entry in the set-up carriage, the function will be the same as a "Normal Program".

When the Constant Divisor/Quotient Transfer lever is moved to quotient transfer position it pivots a long bail which extends across the front of the machine. A downward extending "leg" on the left of this bail pushes the release block disabling link to the rear. The rear end of this disabling link contains a slot which guides the bottom end of the release blocking link. Movement of the disabling link to the rear carries the blocking link to the rear. In this position the blocking edge of the blocking link is held out of the path of the selector set-up clutch latch... permitting the latch to be pivoted to activate the clutch.

Selector

The selector consists of a group of fixed and setable gears mounted on a tubular sleeve. It also contains a double flanged disc, mounted at the right end.

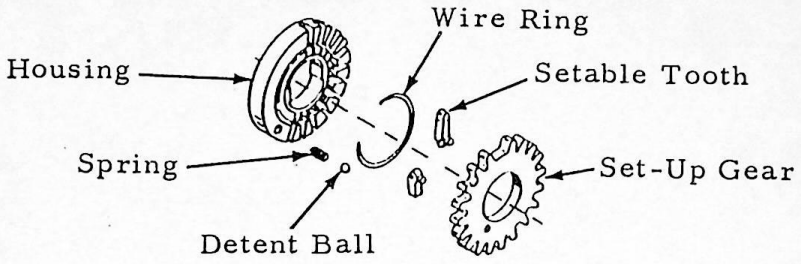


A "C" shaped offset of the selector positioning plate (on the selector carriage) fits between the flanges of this disc. This forms the connection between the selector and selector carriage... and with this connection, any lateral movement of the selector carriage or its selector positioning plate will cause a like movement of the selector. Also, with this connection the selector is allowed limited vertical movement.

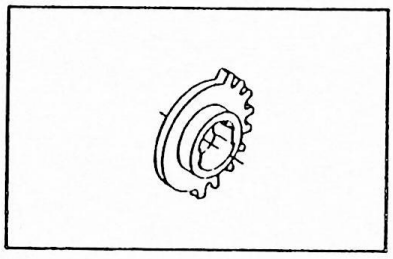
At the top and bottom of the "C" shaped offset are two offset lugs which, when the selector is in its neutral rotary position, align with notches in the top and bottom of the flanges of the connecting disc. Therefore when the selector is raised to engage the clearout gears or lowered to engage the racks, the notches of the disc engage the offset lugs. This refines the engaging alignment of the selector set-up gears and locks the rotary position of the selector while its set-up gears are being turned.

Counting from right to left, the selector contains eleven setable gears and ten fixed gears. The teeth of these gears (both setable and fixed) are alternately staggered to reduce load.

The "setable gears" of the selector consist of a housing which contains a group of setable teeth mounted on a wire ring, a set-up gear which contains a camming slot for positioning the setable teeth to the left or right and a detent ball and spring for holding the assembly in its "set" position.



All of the setable gears contain nine setable teeth. The first column gear contains one additional tooth which is not setable. In their cleared or "zero" position, all setable teeth are positioned to the left. The tenth tooth on the first column gear is always positioned to the left. . . . When these teeth are positioned to the left, they are in the same lateral zone that the fixed selector gears are always in. . . . The fixed selector gears also contain nine teeth each.



When a figure is entered in a setable selector gear, the set-up gear is turned a number of teeth equivalent to the figure and its camming slot positions a like number of setable teeth to the right.

The setable teeth therefore have a left zone and a right zone. . . . During calculation the selector can be positioned so that either the teeth in the right zone or those in the left zone are aligned with the register intermediate gears . In speaking of an amount entered in the selector, we can say that the setable teeth in the right zone represent the "true amount". . . and all teeth in the left zone represent the "complement" of the true amount.

We have stated previously (Page I-D-17) that this high speed calculating mechanism performs subtraction by adding complements. . . . This principle is applied in both short-cut multiplication and division.

Without getting into detail on either of these individual functions at this time, let's look at a simple example of how this principle can be applied.

We will put a "true amount" of 200 in the selector by positioning two setable teeth of the third column gear in the right zone.

This is how the amount would be represented in the "true amount" zone with zeros filled in for the remaining setable gears:

0	0	0	0	0	0	0	0	2	0	0

...and this is how the amount would be represented in the "complement" zone by both fixed and setable gears:

Fixed Gears										Setable Gears										
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	7	9	10

remember...the first column gear contains ten teeth

Let's add this amount to the register three times. The register is shown filled out to its capacity of 21 columns and clear at the start:

Register	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Add True Amount											0	0	0	0	0	0	0	0	2	0	0
Register	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Add True Amount											0	0	0	0	0	0	0	0	2	0	0
Register	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Add True Amount											0	0	0	0	0	0	0	0	2	0	0
Register	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0

Now let's subtract our true amount of 200 by adding its complement:

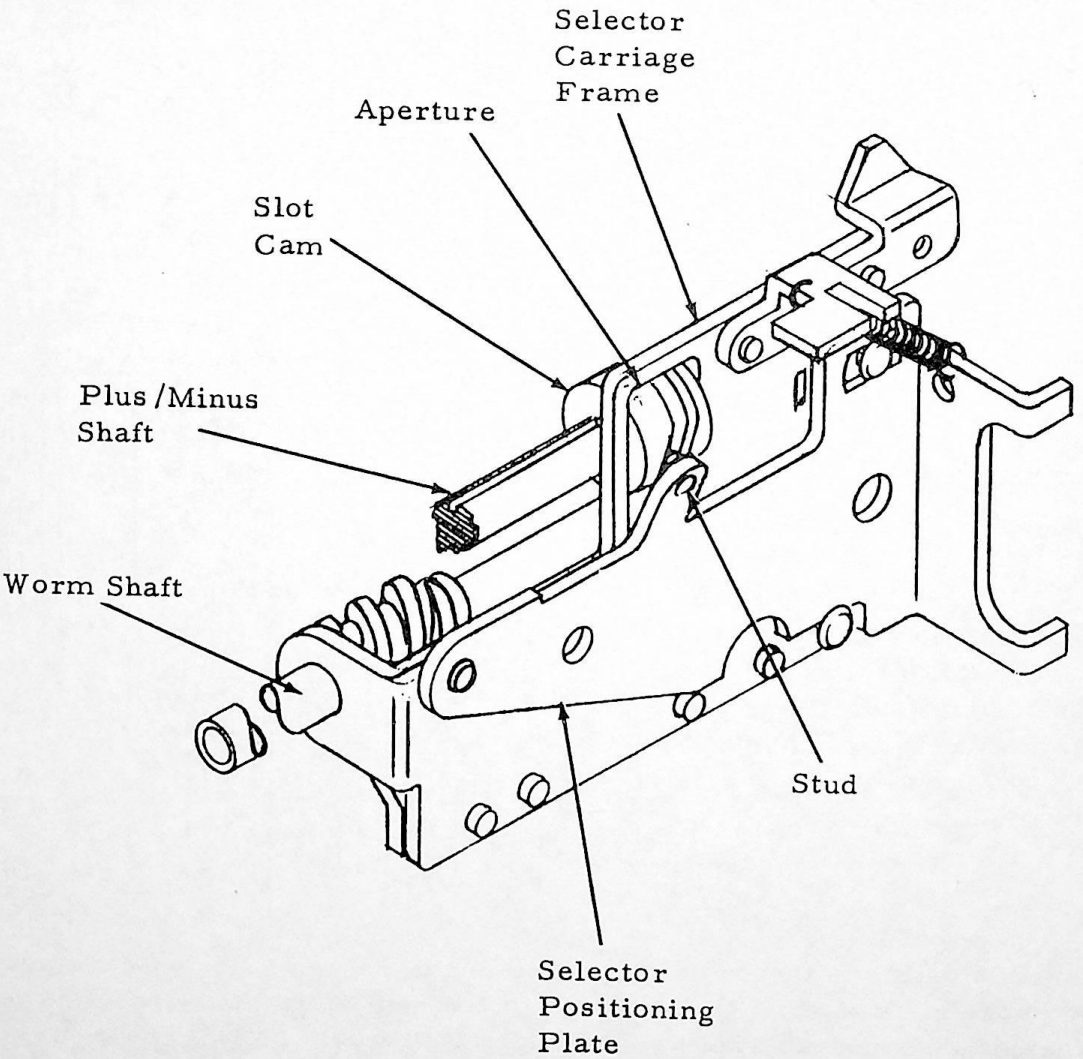
Register	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
Add Complement	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	7	9	10	
Reg.(before carry)	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	3	9	0	
Add Carry-Over	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	
Register	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	

NOTE: The arrows indicate the source of the carry-over....Arrows from above indicate the carry was generated by turning the register gear beyond "nine". Carry-oversfrom this source will be referred to as "primary carrys"....Arrows from below indicate the carry was generated by another carry into a register column in which the gear was in the "nine" position.Carry-overs from this source will be referred to as "transitional carrys"....We differentiate between the two types of carry-overs because a separate carry setting mechanism is provided for each type. More on this later....

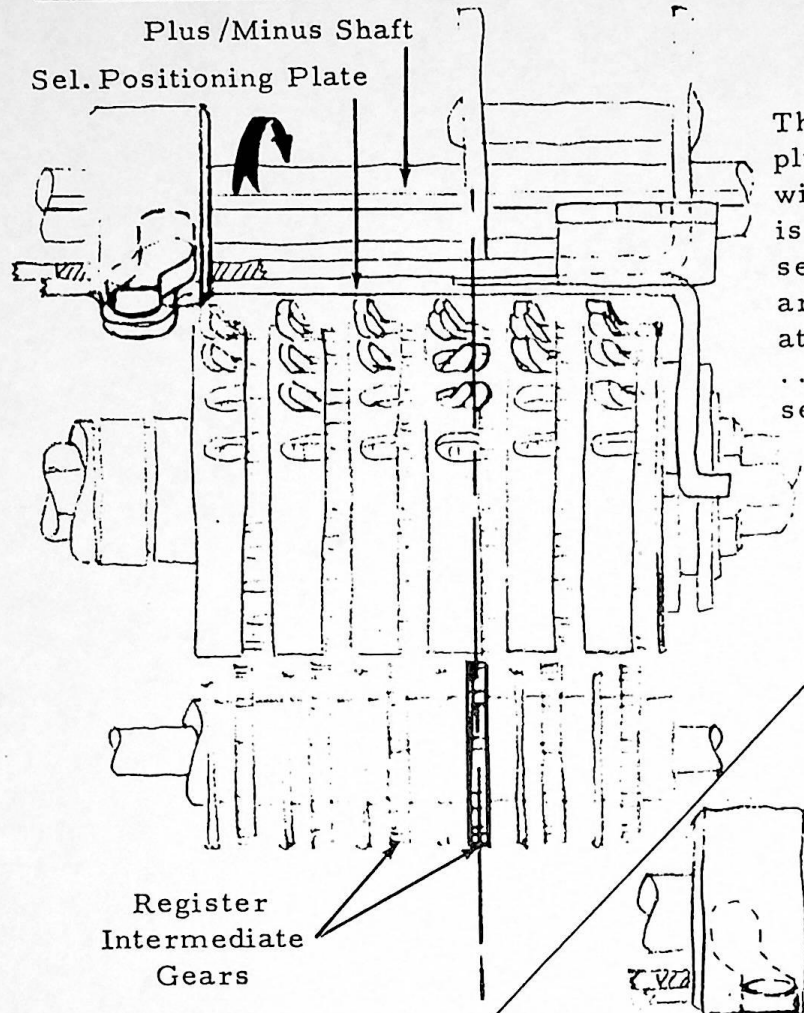
When we held the selector so that the teeth in the "true amount" zone were aligned with the register intermediate gears we added the true amount for the purpose of accomplishing addition .... We will, therefore, refer to this alignment of the selector as the "plus" position.

When we held the selector so that the teeth in the "complement" zone were aligned with the register intermediate gears, we added the complement for the purpose of accomplishing subtraction .... We will, therefore, refer to this alignment of the selector as the "minus" position.

The selector is aligned in either plus or minus position by a drum-shaped slot cam that is "trapped" between the walls of an aperture in the selector carriage frame. This cam is keyed to the plus/minus shaft so that its radial position is governed by the radial position of the shaft. The cam is free to slide laterally on the shaft and its lateral position is governed by the position of the selector carriage. (The position of the selector carriage is controlled by the worm shaft).



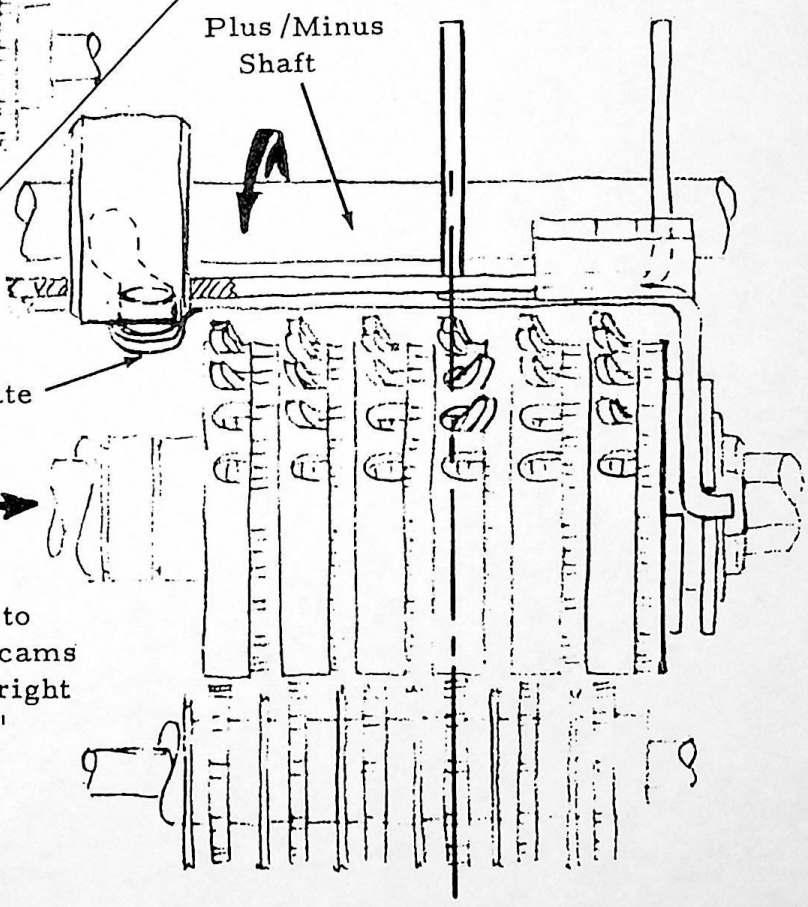
A stud on the selector positioning plate is engaged in the cam slot.



The cam slot is shaped so that, when the plus/minus shaft is turned to its clockwise limit, the selector positioning plate is held to the left. In this position the setable teeth in the "true amount" zone are aligned with the register intermediate gears.... This is the plus position ...and it is the normal position of the selector.

PLUS POSITION

Views From Above



MINUS POSITION

When the plus/minus shaft is turned to its counter-clockwise limit, the slot cams the selector positioning plate to the right so that the teeth in the "complement" zone of the selector are aligned with the register intermediate gears.... This is minus position.

A spring, connected between the selector positioning plate and selector carriage, holds the stud of the plate against the left edge of the cam slot. Its purpose is to negate any sideplay between the stud and the edges of the cam slot.

In multiplication, the radial position of the plus/minus shaft is controlled by the plus/minus sensing bail. This will be described in the multiplication section. In division the radial position of the plus/minus shaft is controlled by the division sequence cam shaft. This will be described in the division section.

(92)

John III c Hamm

PC-1421 TEST #5

1. The enter dividend program bail will operate which of the following during the first 24° of the machine cycle?

   A. Set-up carriage escapement program slide.
   Set-up carriage engagement program slide.
   Set-up carriage return program slide.
   Hold-up latch disabling program slide.
   Enter dividend program slide.
   Dividend symbol slide.

   B. Set-up carriage engagement program slide.
   Set-up carriage return program slide.
   Enter dividend program slide.
   Dividend symbol slide.

   (C.) Set-up carriage escapement program slide.
   Set-up carriage engagement program slide.
   Set-up carriage return program slide.
   Enter dividend program slide.
   Dividend symbol slide.

2. The dividend is entered into which of the following set of gears?

   (A.) Register gears

   B. Selector gears

   C. Multiplier/quotient gears

   D. Accumulator gears

3. Which of the following statement or statements are true?

   (A.) The whole number capacity of the selector is 11 digits.

   (B.) The entry capacity of the selector is 11 digits.

   (C.) The decimal capacity of the selector is the setting of the right control knob.

   (D.) The whole number capacity of the selector can be determined by subtracting the setting of the right control knob from 11.

   E. The setting of the right control knob will determine the number of places the selector will shift to the left before it receives an entry from the set-up carriage on a multiplicand entry cycle.

4. Which of the following statement or statements are true?

   (A.) The hard lock signals the whole number capacity of the selector has been exceeded and it will prevent multiplicand or division key depression.

   B. The hard lock is activated by the right hand stop steps of the middle decimal stop shaft.

   C. The soft lock when active will block the multiplicand bail from pivoting.

   (D.) The soft lock signals the decimal capactiy of the selector has been exceeded and it will prevent releasing of the main cam shaft clutch.

   E. The multiplicand bail is operated by direct contact of the multiplicand and division keys.

   (F.) With a 4-4 decimal setting and eight numeral key entrys before the decimal key is depressed and four numeral key entries after the decimal key depression, the hard lock will be active.

5. With 3 or more decimals set, how is the set-up carriage aligned with the racks on a selector entry cycle?

   A. By the stop lug limiting on the right stop steps of the lower stop shaft.

   B. By the upper lug of the decimal carriage limiting on the stop steps of the upper decimal stop shaft.

   (C.) By the stop lug limiting on the right stop steps of the middle stop shaft.

   D. By the escapement pawl engaged with the escapement ratchet gear.

6. Complete the following statements.

   A. When the whole number capacity of the selector has been exceeded the Hard lock will be active.

   B. When the decimal capacity of the selector has been exceeded the Soft lock will be active.

7. What two conditions are necessary for a normal program on a selector entry cycle?

   A. Right lever in constant multiplicand, constant division position.

   B. Figures in the setup carriage.

8. Explain the function of each of the following cams during their 360° rotation of a selector entry cycle.

   A. Right cam:

The right cam positions the decimal actuator arms full right into alignment with the middle decimal selecting bar & also moves the lateral positioning slide rearward which positions the selector into alignment with the clear gears & the racks. The cam then releases the mechanism after the racks are in their full forward position & allows the selector to return right, in alignment with the register intermediate gears, and the decimal actuator arms to return left, in alignment with the [illegible]

B. Middle cam: The middle cam positions the selector up into engagement with the clear gears (after the selector is positioned to the left by the right cam and during the rearward movement of the racks) and then allows the selector, under spring tension, to move into engagement with the racks during the forward movement of the racks. After the racks have returned, the cam then positions the selector into its neutral position between the clear gears & the racks.

C. Left cam: The left cam operates the selector clear gear shaft (after the selector has been positioned to the left by the right cam & after the selector is in engagement with the clear gears by the [redacted] cam) on which shaft the individual clear gears mesh with the movable gears & clear them to their zero position. The clear shaft then returns to neutral after the selector moves out of mesh with the clear gears. during the forward cycle of the racks.

9. In which zone will the selector setable teeth be for the following?

   A. The true amount: right

   B. The complement amount: left.

10. Which of the following statement or statements are true?

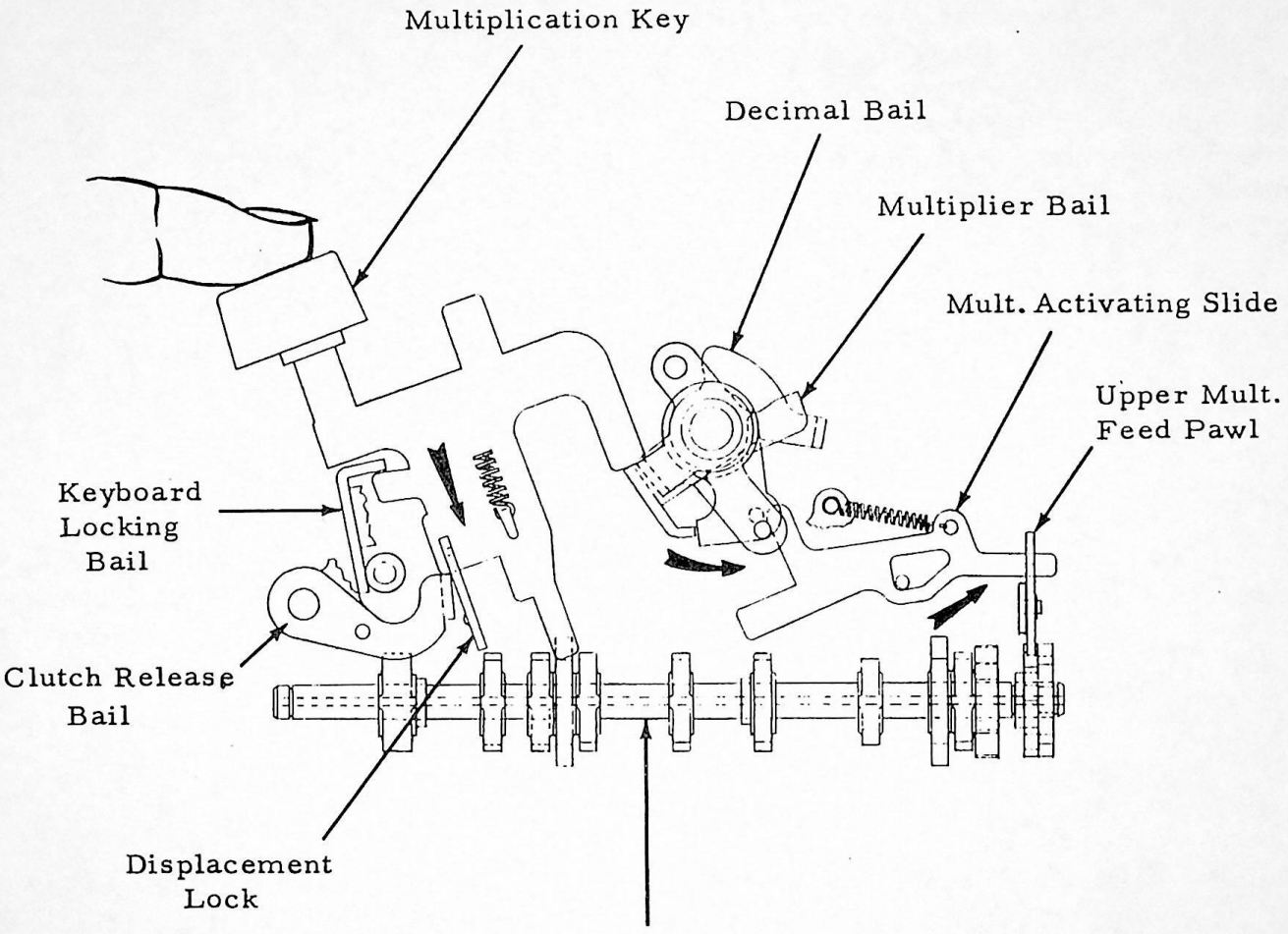
   (A.) All selector setable gears contain 9 setable teeth.

   B. The neutral position of the selector is with the setable teeth in the left zone in alignment with the register intermediate gears.

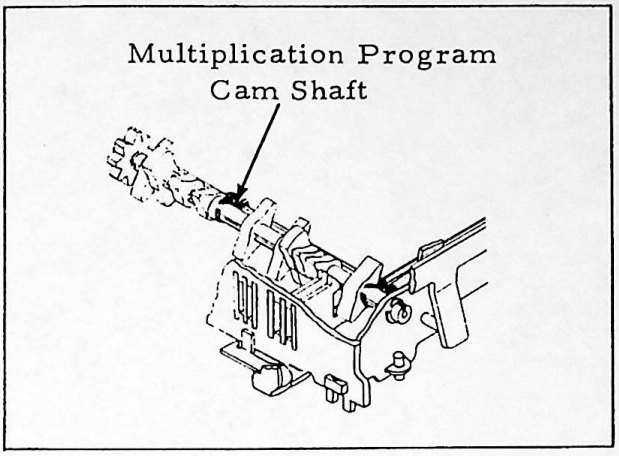
   C. The selector is coupled directly to the selector carriage.

   D. The first setable gear of the selector contains 10 setable teeth.

   (E.) The plus and minus shaft controls the position of the selector positioning plate and selector for plus or minus cycles of the selector.


Multiplication Key
Decimal Bail
Multiplier Bail
Mult. Activating Slide
Upper Mult. Feed Pawl
Keyboard Locking Bail
Clutch Release Bail
Displacement Lock
Multiplication Program Cam Shaft

The multiplication operation is controlled by the Multiplication Program Cam Shaft.



The multiplication program calls for two complete cycles of the main cam shaft.... On the first cycle, the multiplier is removed from the set-up carriage...printed ...then entered in the M/Q gears. On the second cycle the main cam shaft is stopped at the hold-up (30°) position while the high speed mechanism performs the actual multiplication. When the multiplication is completed, the main shaft cycle is resumed... removing the product from the register and printing it.

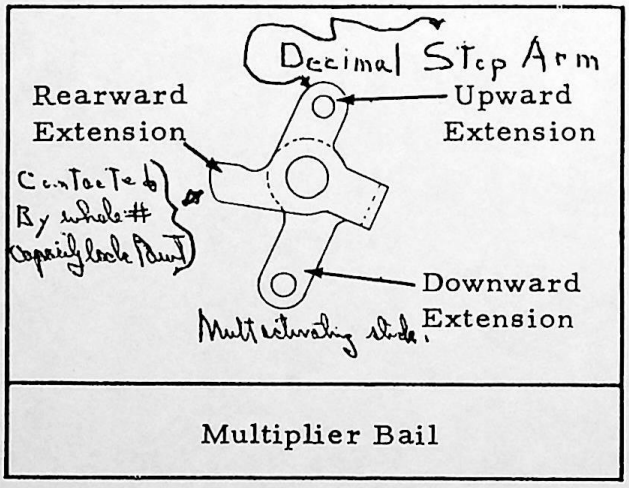
Depression of the Multiplication Key operates the Keyboard locking bail, the clutch release bail, the displacement lock, the decimal bail and the multiplier bail.

Capacity Locks

The multiplier entry capacity is ten digits....Since this can be divided between whole number and decimal digits, these two individual capacities are expressed as follows:

> The Whole Number capacity of a multiplier entry is ten...less the setting of the left decimal knob.
>
> The Decimal capacity of a multiplier entry corresponds to the setting of the left decimal knob.

The whole number capacity lock mechanism is a "hard lock" and the decimal capacity lock mechanism is a "soft lock"...with the same distinguishing features as described on Page V-B-2 for the hard and soft selector capacity locks.



Multiplier Bail

The multiplier bail has three extensions ...a rearward and upward extension at its left end...and a downward extension at its right end.

Mult. Cam Shaft and Program Slides.

First machine cycle.
Machine at 30° hold-up.
Mult. cam shaft at 45°.
Program feed plate to the left.

Step 1 (following program slides to the left):
#5 Set-up carriage escapement (and drives #4).
#4 Set-up carriage engagement (and locks decimal key and KB).
#7 Set-up carriage return (and moves the decimal bail to the right).
#8 Enter multiplier (and moves the decimal actuator arms to the ½ right position).
#20 Repeat
#8 Mult/Minus symbol slide driven ½ right and controls left symbol rack.

End of first machine cycle.
Mult cam shaft at 90°.
Program feed plate restored to the right.

Step 2:
#8 Enter multiplier "T" arm is driven down and then restored.
#20 Repeat
All other slides restore.

Second machine cycle.
Machine at 30° hold-up.
Mult. cam shaft at 135°.
Program feed plate to the left.

Step 3:
#9 Register total (mult product).
#13 Shift and cycle clutch trip (trips high speed mult.).

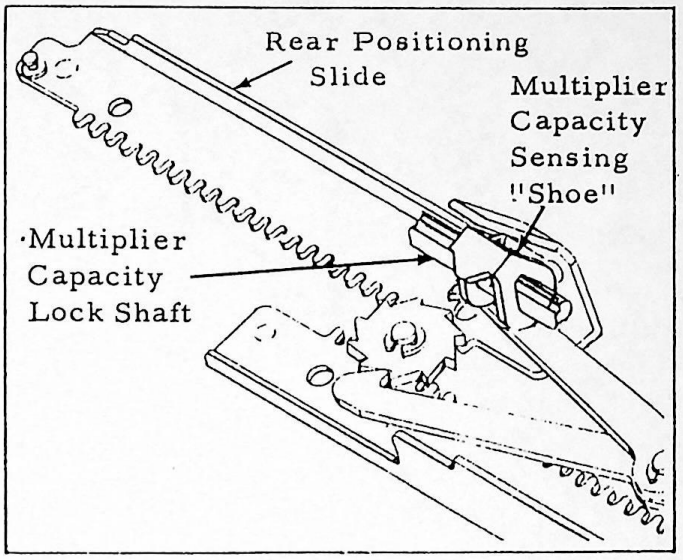
#2 & #3 total/neg total symbol slides go full right (positive total) and control #2 symbol rack.

High Speed multiplication occurs.

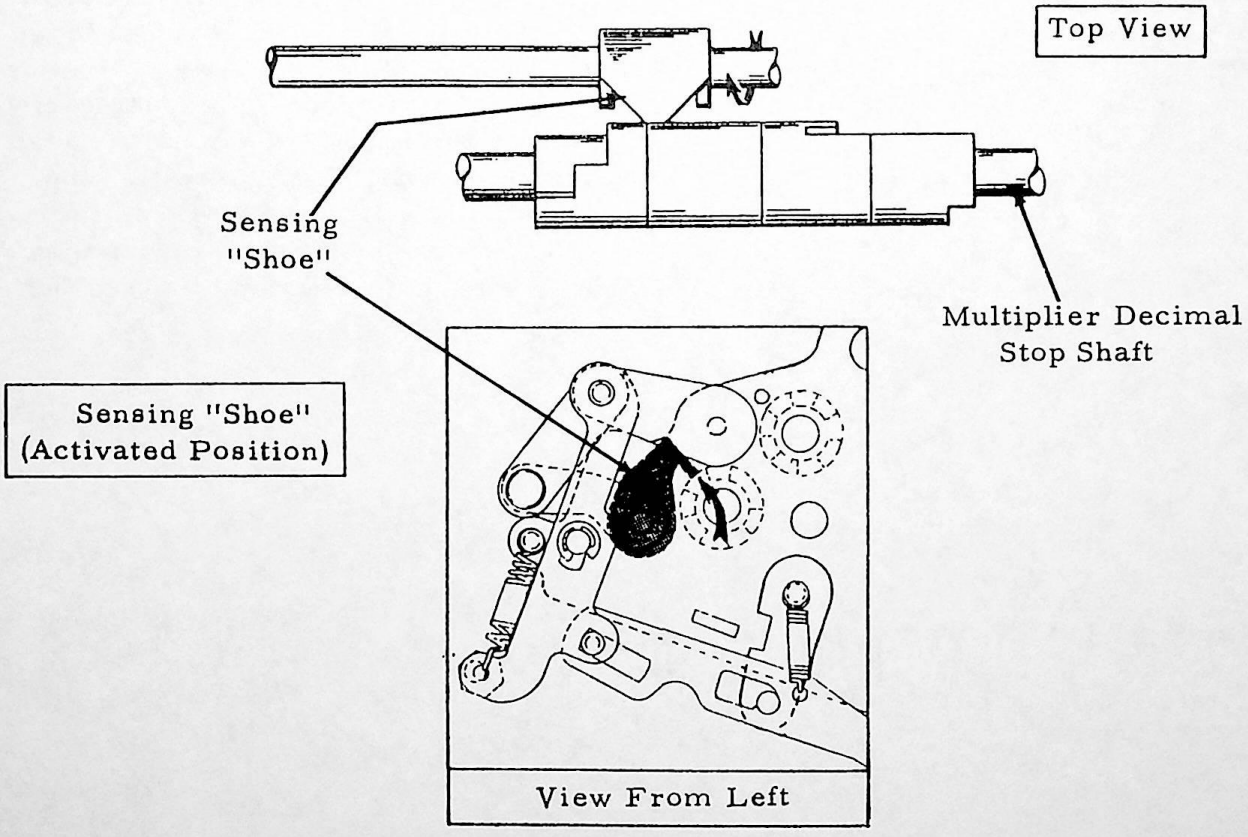
End of second machine cycle.
Mult cam at 180° (neutral).
Program feed plate restored to the right.
All slides restored.

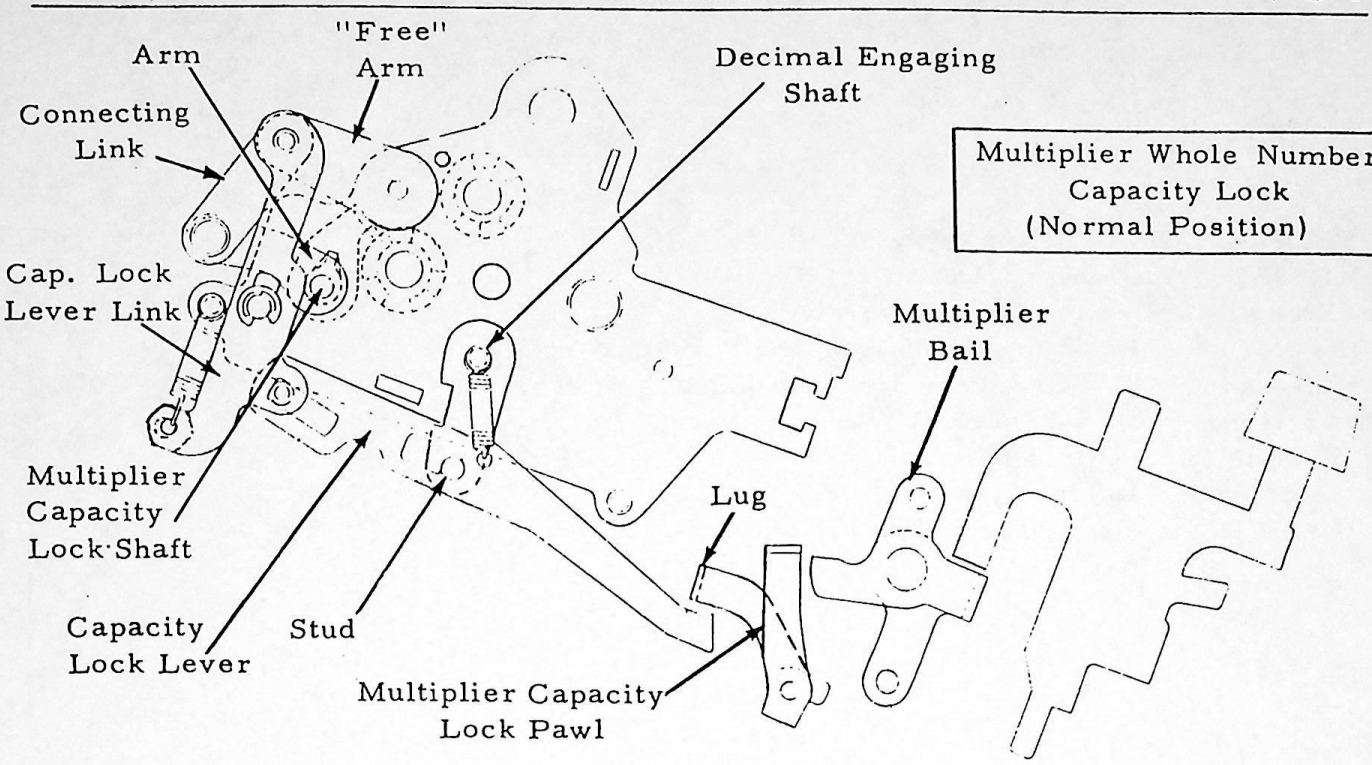
Multiplier Whole Number Capacity Lock (Hard Lock)

The rearward extension of the multiplier bail is provided to prevent depression of the multiplication keys if the whole number capacity of the multiplier has been exceeded by the entry in the set-up carriage. A capacity sensing "shoe" is keyed to the multiplier capacity lock shaft and slides laterally with the rear positioning slide for the set-up carriage.

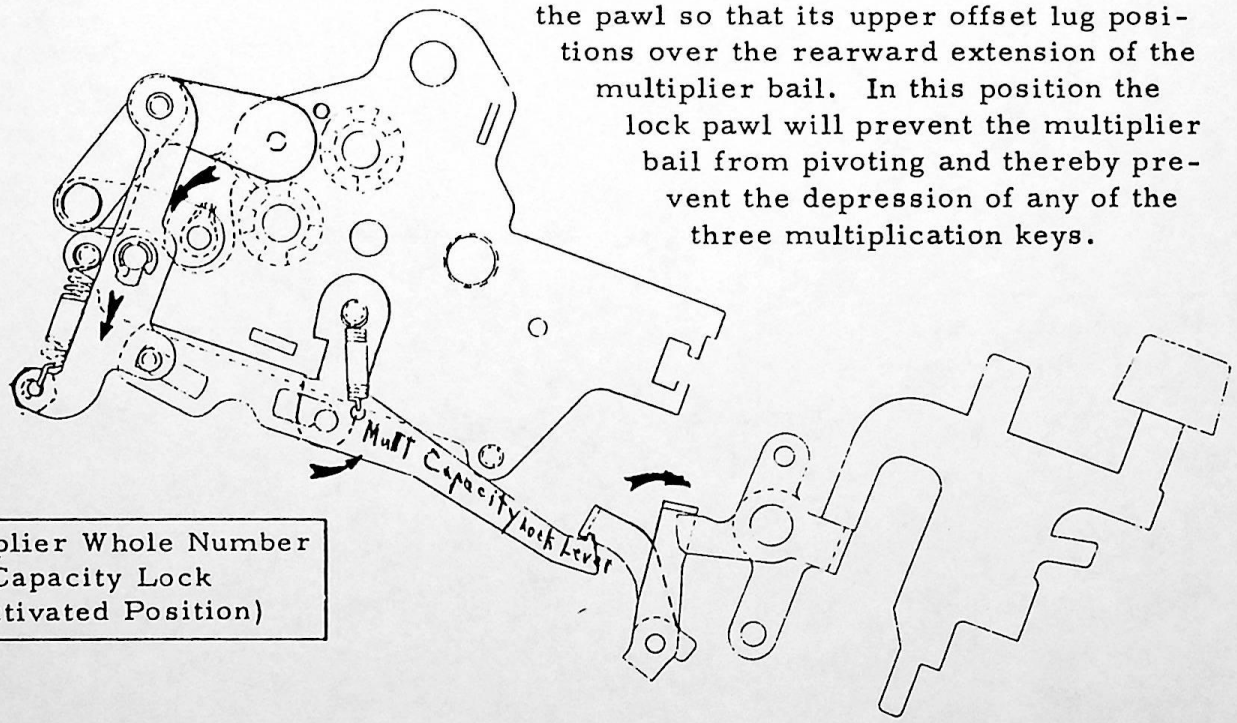


When the whole number capacity is exceeded by the entry in the set-up carriage the "shoe" will be cammed counter-clockwise (as viewed from the left) by the appropriate stop on the multiplier decimal stop shaft.

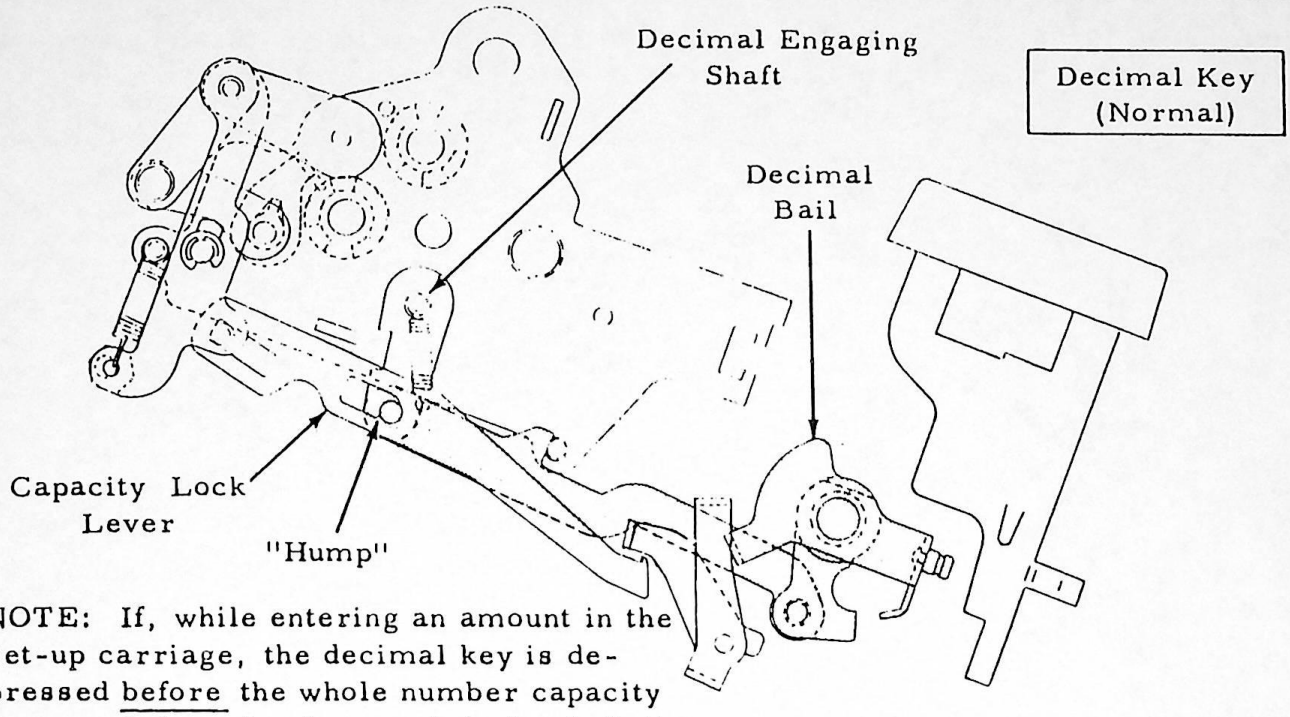




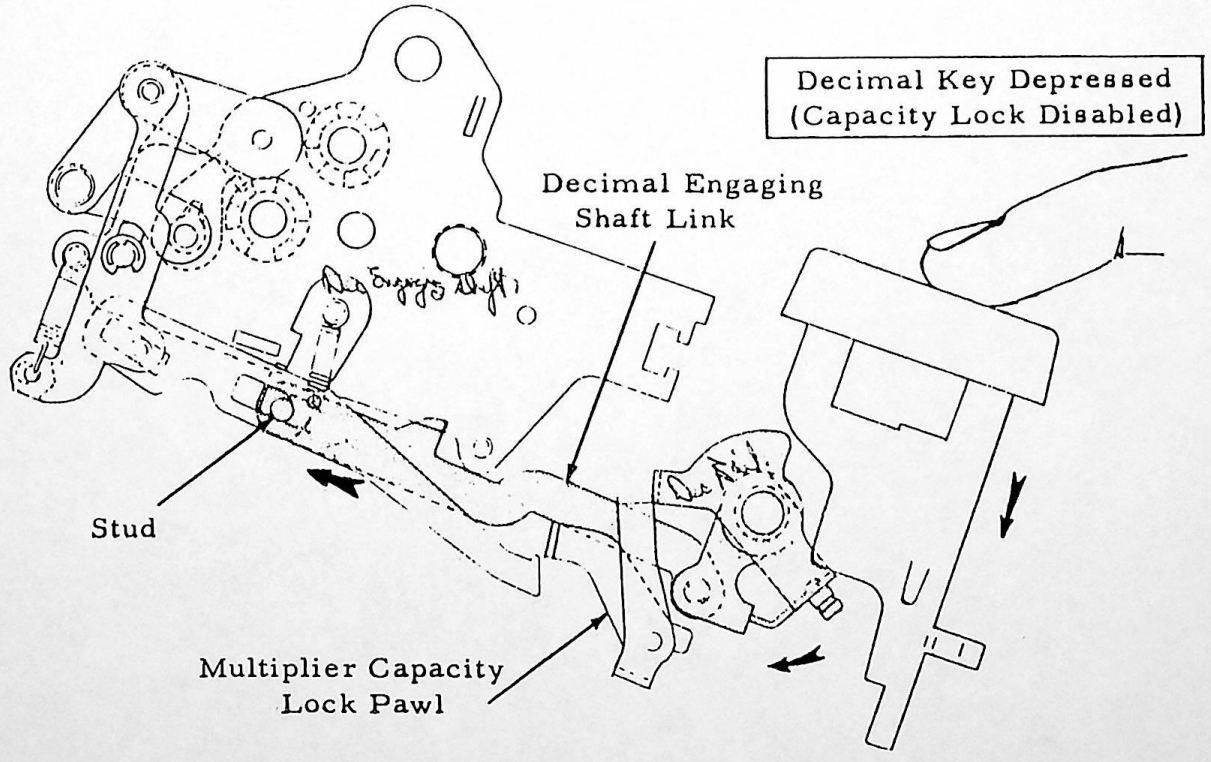
This movement of the "shoe" pivots the multiplier capacity lock shaft. An arm on the left end of the shaft pulls down the connecting link which pulls the link of the capacity lock lever down with it. (NOTE: These two links are joined by a stud on an arm which pivots freely on the left end of the selector capacity lock shaft. This arrangement provides the same upper axis for operating the multiplier capacity lock lever as is used for operating the selector capacity lock lever.) The downward movement of the link for the multiplier capacity lock lever causes the lever to pivot on the stud of the left arm on the decimal engaging shaft... raising the forward end of the lever. The forward end of the lever engages the rear offset lug of the multiplier capacity lock pawl... pivoting the pawl so that its upper offset lug positions over the rearward extension of the multiplier bail. In this position the lock pawl will prevent the multiplier bail from pivoting and thereby prevent the depression of any of the three multiplication keys.



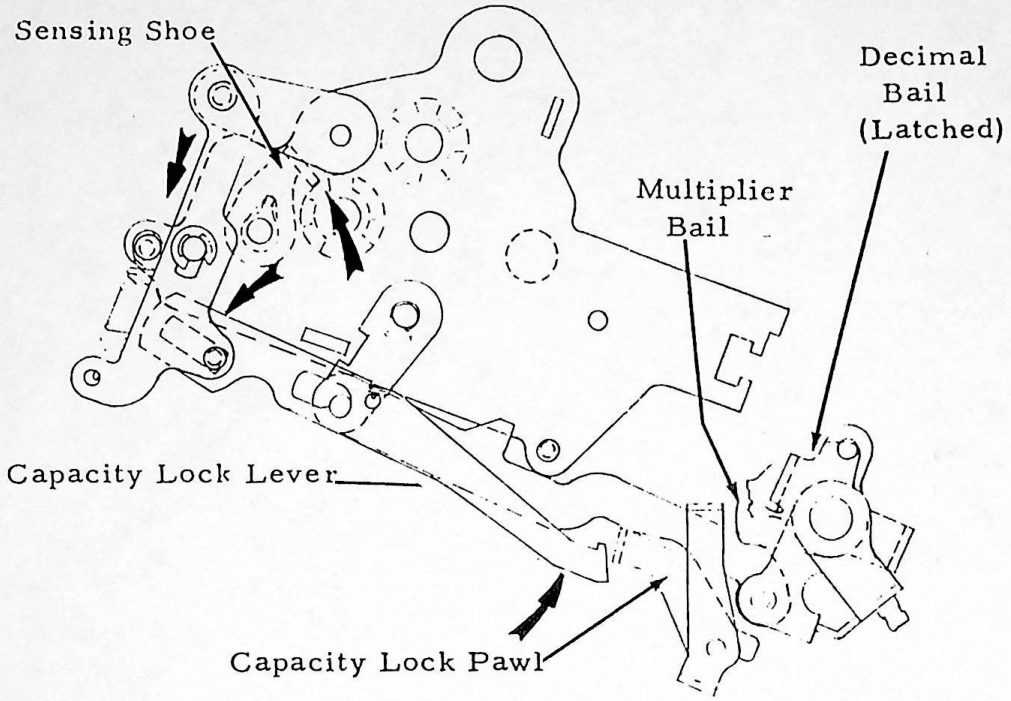
Multiplier Whole Number Capacity Lock (Activated Position)



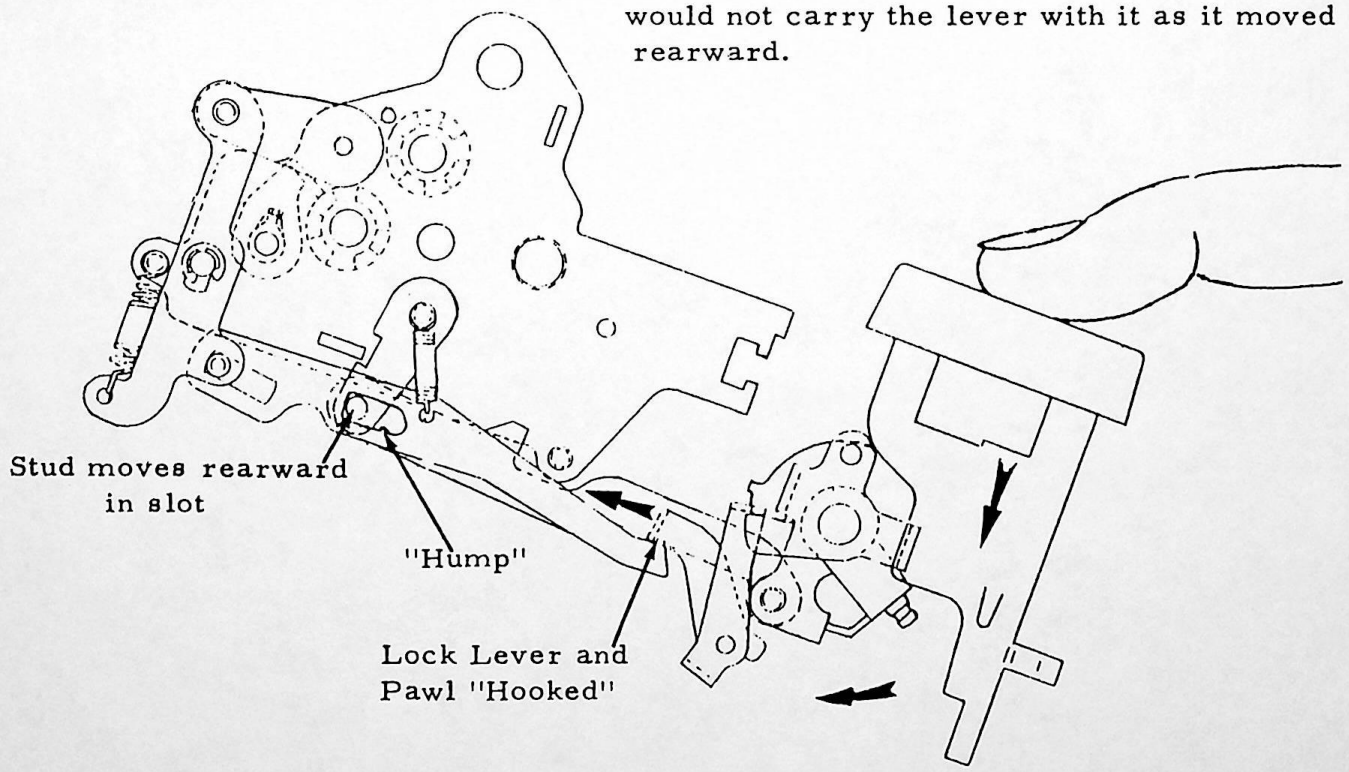
NOTE: If, while entering an amount in the set-up carriage, the decimal key is depressed before the whole number capacity is exceeded, and subsequent decimal digits are entered, this lock will be disabled. Depression of the decimal key pivots the decimal bail which pushes the decimal engaging shaft link rearward. The link is attached to the same stud of the left arm on the decimal engaging shaft that the capacity lock lever pivots on. The rearward movement of the link pushes the stud to the rear (pivoting the decimal engaging shaft). The capacity lock lever, when not activated, is held upward by a spring so that the stud engages the lower edge of the slot in the lever. This edge has a "hump" form which the stud engages and the stud then carries the lever to the rear with it... moving the forward end of the lever out from under the rear offset lug of the multiplier capacity lock pawl.



Thereafter, if the capacity lock lever is pivoted thru the action of the sensing "shoe", it will not engage the multiplier capacity lock pawl... so the three multiplication keys could still be depressed.



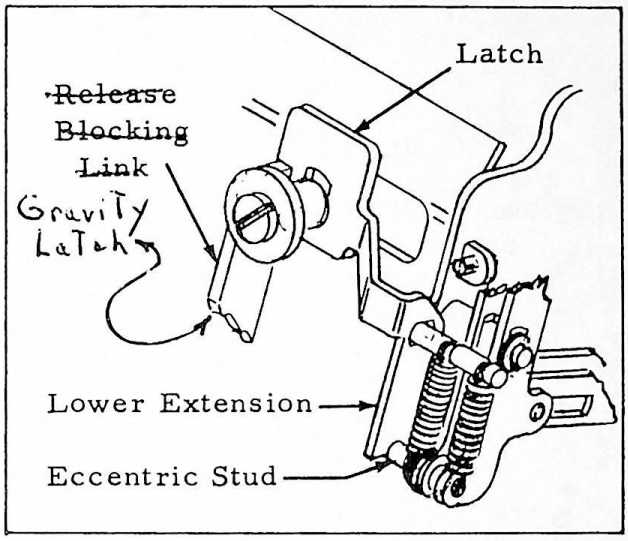
If, however, while entering an amount in the set-up carriage, the decimal key is depressed after the whole number capacity is exceeded, the lock will not be disabled .... The forward end of the capacity lock lever will have "hooked" the rear offset lug of the multiplier capacity lock pawl. Then the stud of the left arm on the decimal engaging shaft would cam over the "hump" on the bottom edge of the slot and the stud would not carry the lever with it as it moved rearward.



Latch For Whole Number Capacity Lock

With the left decimal knob set at 3, and fifteen numeral key depressions or with the knob set at 4 and fourteen, fifteen or sixteen numeral key depressions, the set-up carriage will be "stepped" far enough to the left so that the capacity sensing shoe drops down off the decimal steps on the right side of the multiplier decimal stops. To prevent the unlocking of the multiplication keys when this happens, a latch has been provided to hold the whole number capacity lock lever in activated position.

This latch is mounted on the back of the decimal unit at its left end. A "step" of the latch is positioned over the top of the release blocking link. The release blocking link is held upward by the rear positioning slide when the set-up carriage is in "home" position. (See Page V-B-20). With the release blocking link held upward, it keeps the latch pivoted so that the lower extension of the latch does not contact the eccentric stud on the rear of the capacity lock lever assembly.



When a digit is entered in the set-up carriage the rear positioning slide moves to the right, permitting the release blocking link to drop. As the link drops it releases the latch which starts to pivot but immediately contacts the face of the eccentric stud. If subsequent digits are entered and the whole number capacity exceeded, the sensing "shoe" will move the rear end of the capacity lock lever assembly down.... This will move the eccentric stud out of the path of the latch which will then pivot (by gravity) over the top of the eccentric stud.

If the set-up carriage is then "stepped" to the left far enough to permit the sensing "shoe" to drop off a decimal stop step... the latch will hold the capacity lock lever activated.

When the set-up carriage is restored to "home" position, the rear positioning slide raises the release blocking link which pivots the latch off the eccentric stud... permitting the capacity lock lever assembly to be restored to neutral by its spring.

NOTE: The above examples (depressing numeral keys 14, 15 or 16 times) are of course, mis-operations... since the set-up carriage entry capacity is twelve digits. The same mis-operations will result in the unlocking of the division and enter multiplicand keys with the reverse decimal settings (0-3 thru 7-3 enter 15 digits... 0-4 thru 7-4 enter 14, 15 or 16 digits). No lock latch is provided for the selector whole number capacity lock lever, however, since such mis-operation would simply result in either an overcapacity division or the dropping of digits in the multiplicand entry....

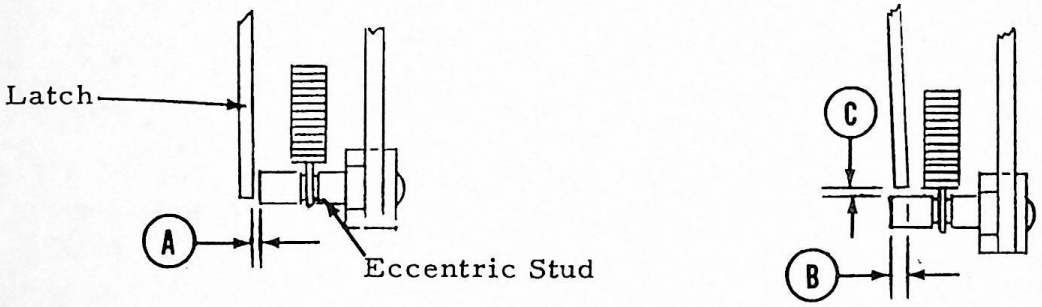
NOTE: Continued

The lock latch is provided for the multiplier whole number capacity lock lever since such mis-operation could permit the entry of digits in the eleventh column multiplier/quotient gear. If the digit "9" were entered in this gear as a result of such mis-operation and it was preceded in the tenth column by another "short-cut" digit (6 thru 9) it would cause a jam and possibly result in damage to the mechanism.

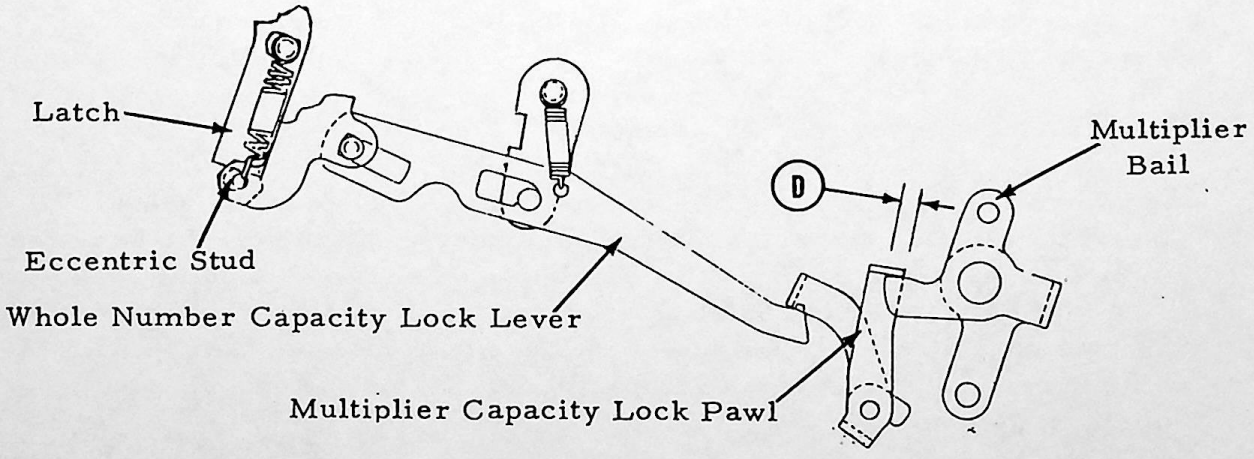
Adjustment

NOTE: Latch must be free.

1. Check restoring clearance and lateral hold....Latch must have slight lateral clearance (A) at face of eccentric stud with set-up carriage in home position... and better than full hold (B) above eccentric stud when whole number capacity lock lever is activated. (Dec. 4-0...depress a numeral key seven times).... Form lower extension of latch as required.

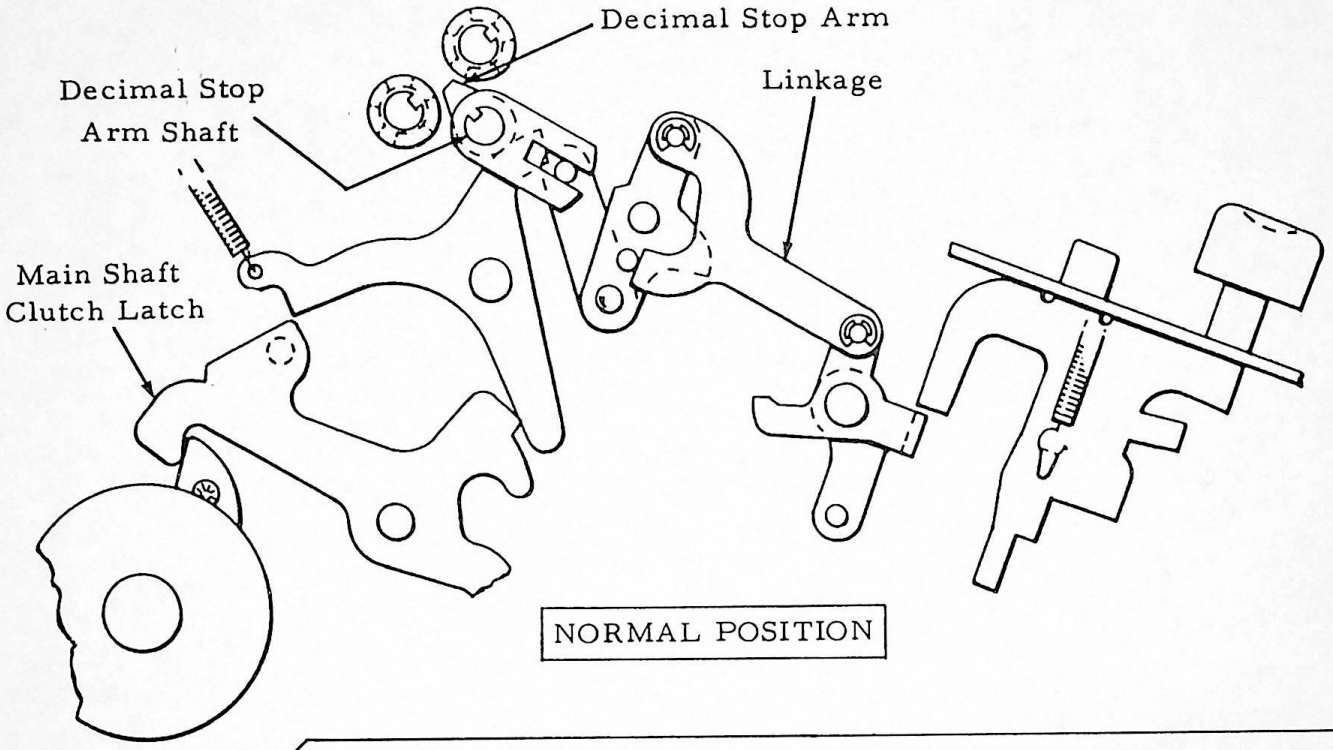


2. Check engaging clearance and hold of lock pawl....Latch must have enough vertical clearance (C) above eccentric stud to move freely over the stud when whole number capacity lock lever is activated (as described in preceding paragraph) and multiplier capacity lock pawl must maintain a safe hold (D) over rearward extension of multiplier bail when latch is holding capacity lock lever activated. (Decimal 4-0...fifteen numeral key depressions)....Adjust eccentric stud as required.

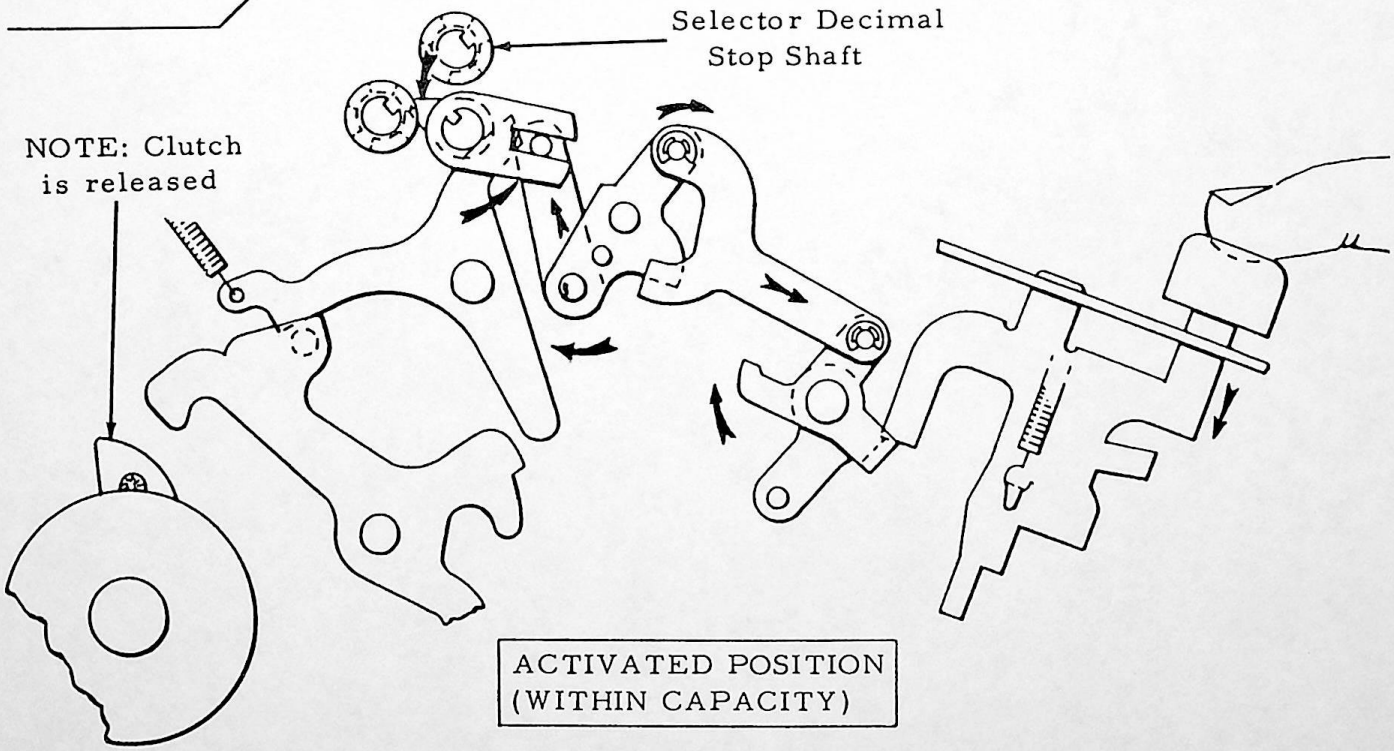


Multiplier Decimal Capacity Lock (Soft Lock)

The upper extension on the left end of the multiplier bail operates the linkage which pivots the decimal stop arm shaft. If the multiplier decimal capacity has not been exceeded, the decimal stop arm is pivoted down to align with the stops of the multiplier decimal stop shaft...where it will stop the escapement of the set-up carriage at the selected decimal position (provided a total of at least three decimals have been selected).

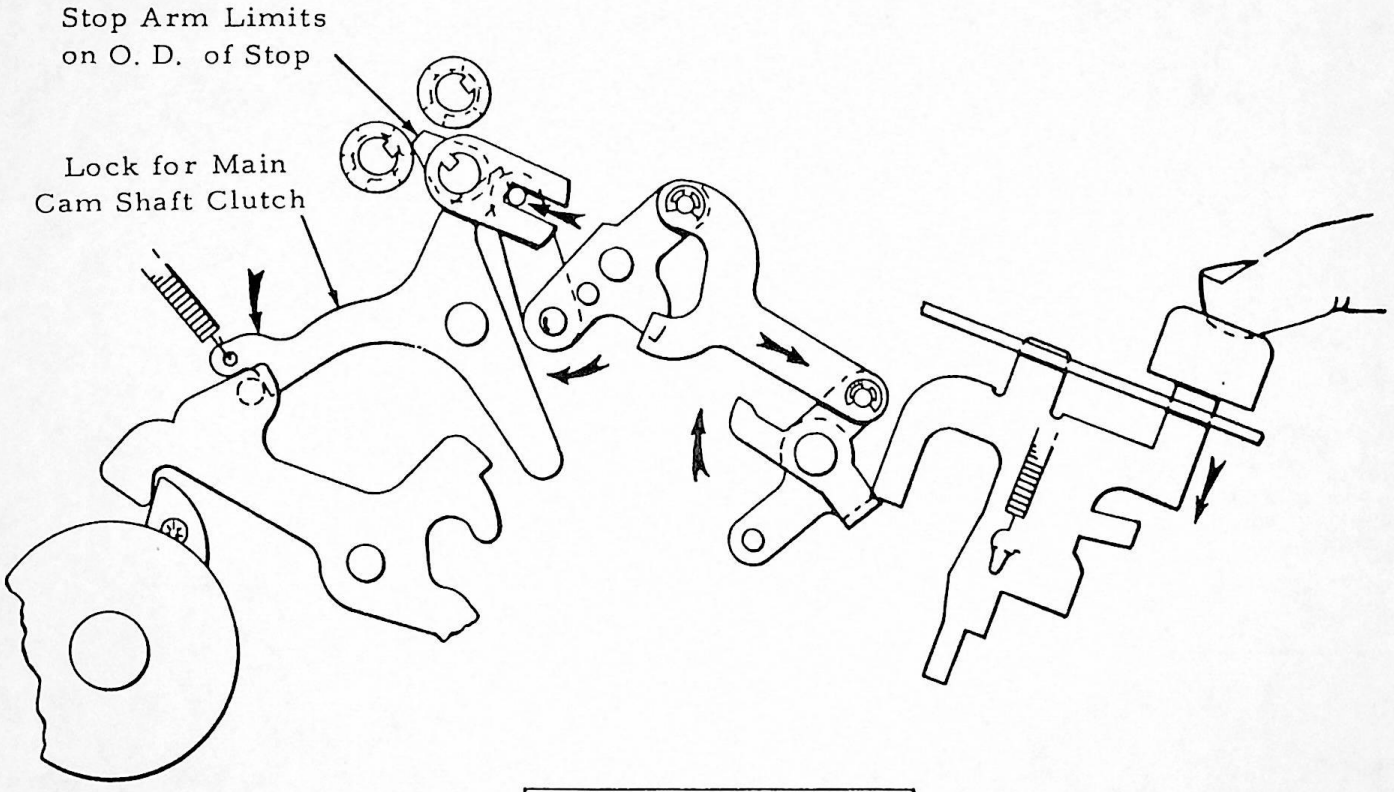


NORMAL POSITION



ACTIVATED POSITION
(WITHIN CAPACITY)

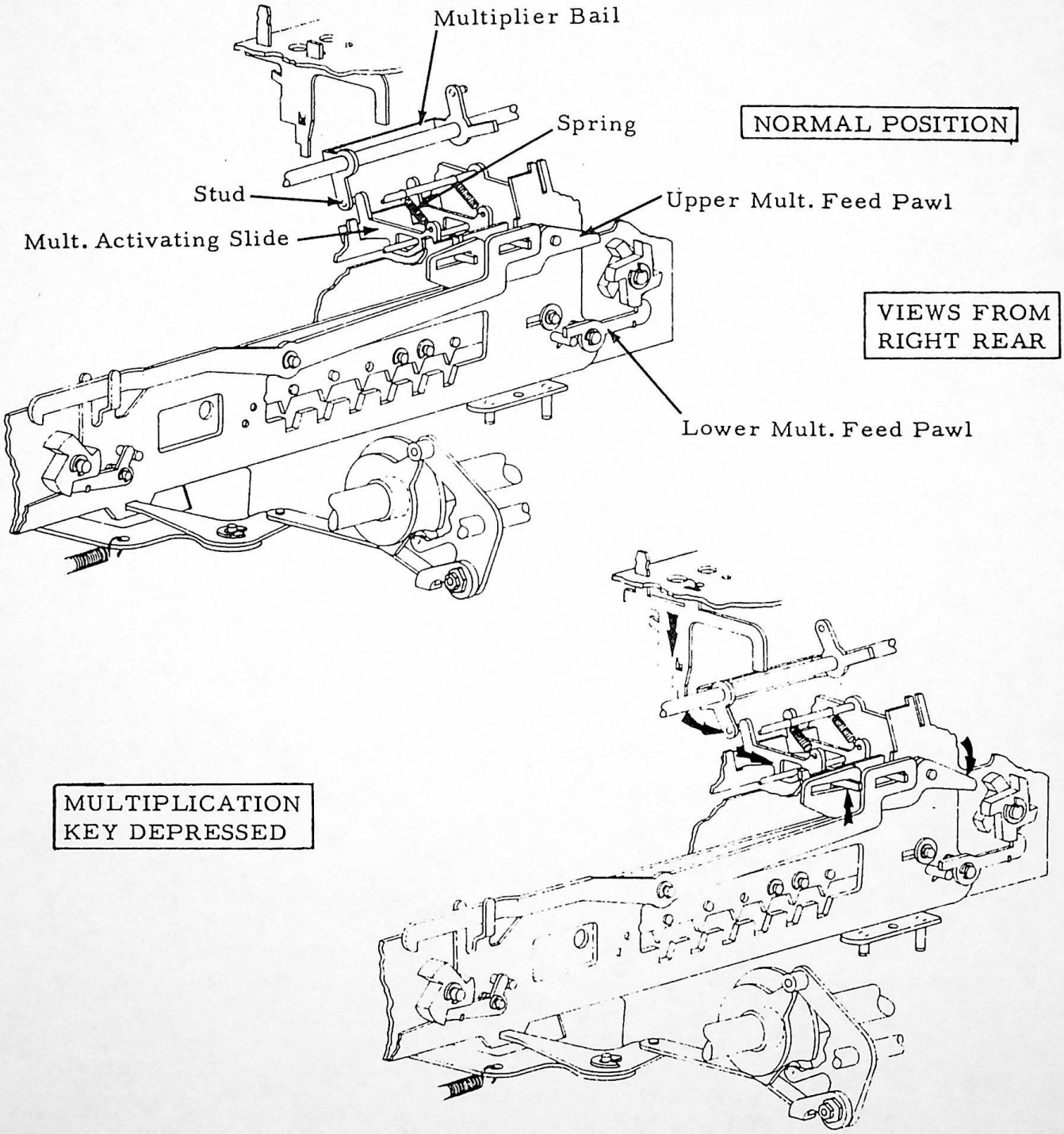
If the multiplier decimal capacity has been exceeded, (remember, the decimal capacity of the multiplier corresponds to the setting of the left decimal knob. . . provided at least one decimal has been set at the knob), the decimal stop arm will limit on the outside diameter of the stop . . . preventing the stop arm shaft from pivoting. While this limiting of the stop arm shaft does not prevent the further depression of the key, it does cause the linkage to yield in such a manner that it pivots the lock for the main cam shaft clutch latch into engagement with the stud of the clutch latch. . . preventing the release of the clutch.



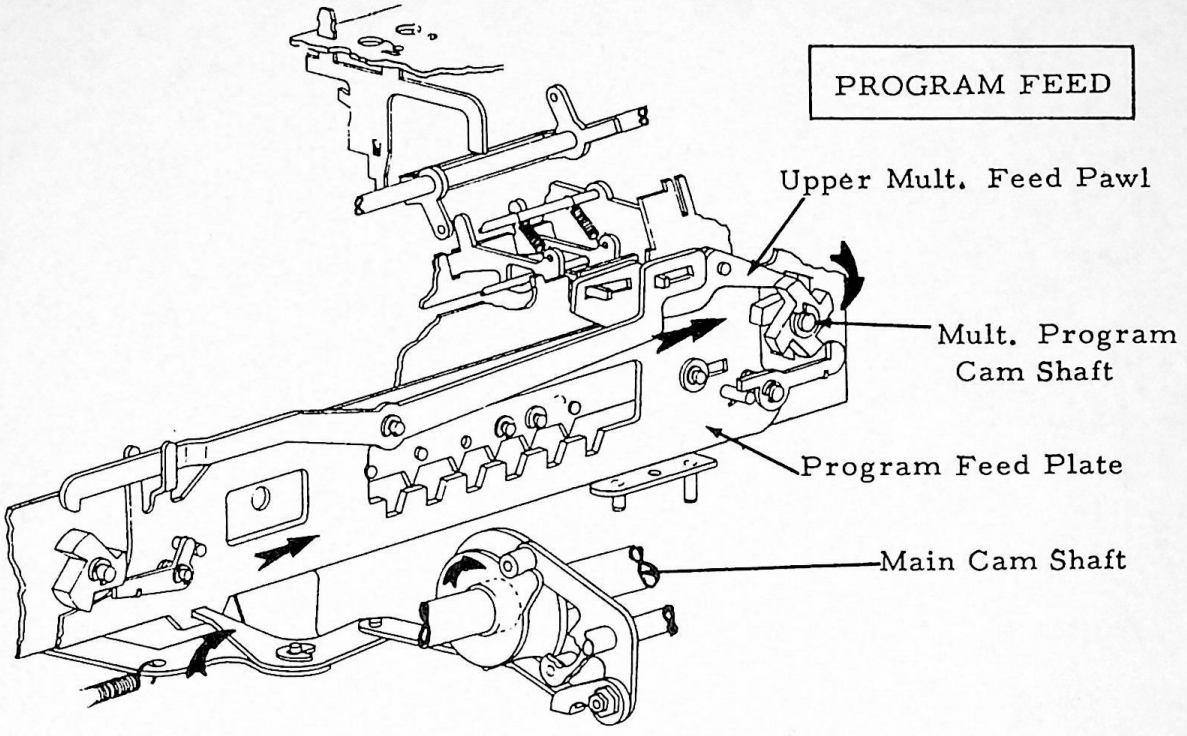
ACTIVATED POSITION
(OVER CAPACITY)

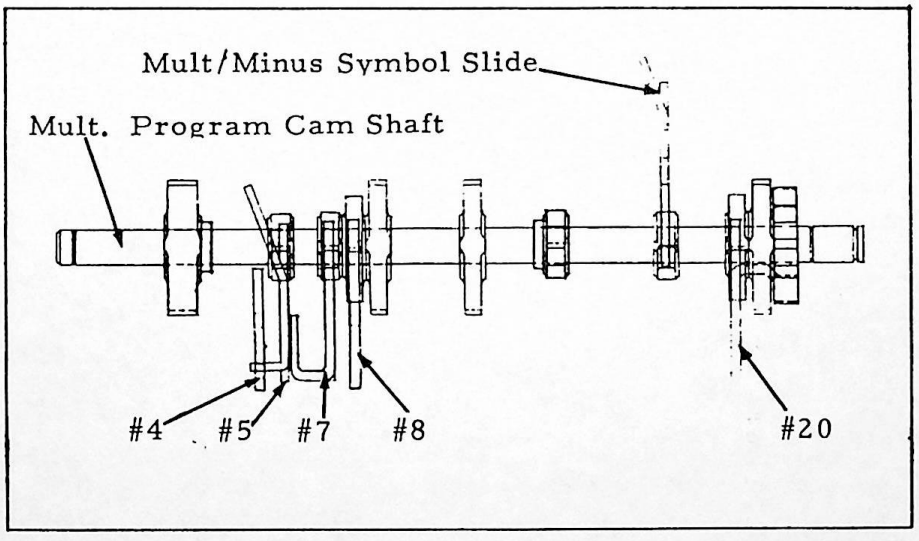
Program Feed

A stud on the lower right end extension of the multiplier bail pushes the mult. activating slide to the rear and a spring lifts the rear end of the slide upward. . . . The rear extension of the mult. activating slide, engaged in a slot of the upper mult. feed pawl, pivots the operating tip of the pawl down into alignment with the inner feed ratchet gear on the rear end of the multiplication program cam shaft.



As the main cam shaft cycles, the program feed plate is driven to the left. The upper mult. feed pawl indexes the mult. program cam shaft to its first active detent position





As the shaft is indexed, its program cams activate the following program slides:

Set-Up Carriage Escapement (#5)
which activates the Set-Up carriage Engagement (#4)
Set-Up Carriage Return (#7)
Enter Multiplier (#8)
Repeat (#20)

Another cam pushes the mult/minus symbol slide to its half right position where, when the racks move rearward, its stop lug will contact the forward step of the left symbol rack... stopping the rack when it has positioned the multiply symbol on the symbol wheel in alignment with the platen.

The functions of program slides #4, #5 and #7 have been described previously for other operations. To review them briefly...

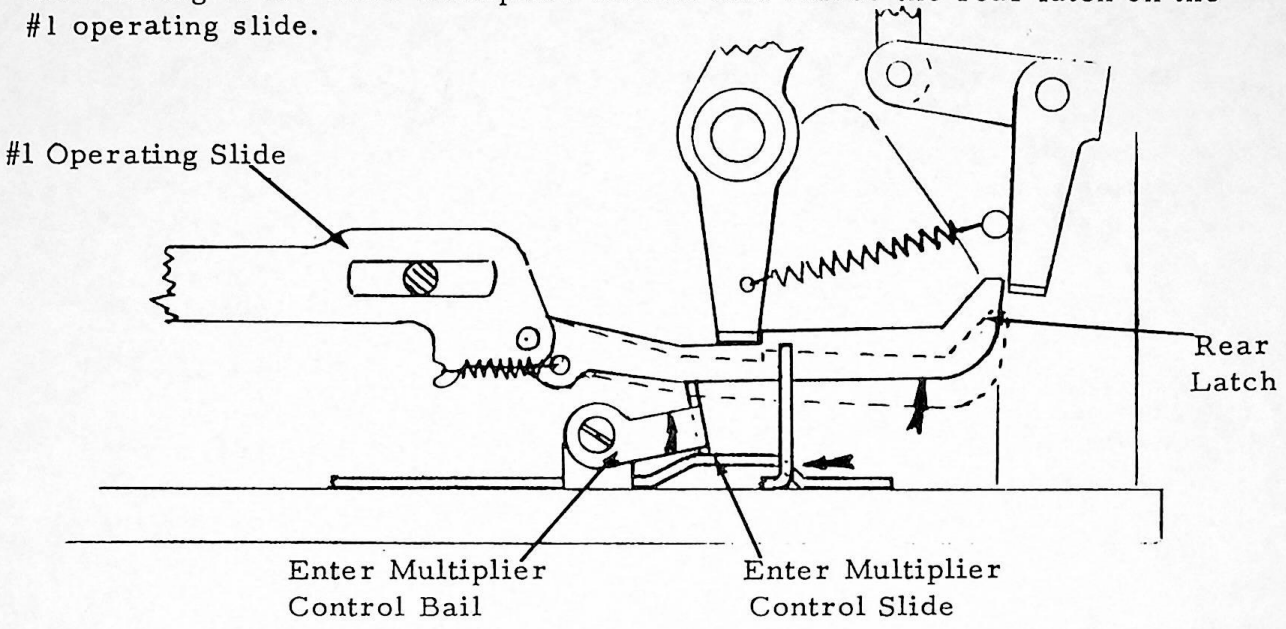
The set-up carriage engagement program slide (#4) operates the set-up carriage control slide which raises the set-up carriage control bail. The set-up carriage control bail raises the drive arm on the #2 operating slide into alignment with the lower end of the set-up carriage positioning arm. This will cause the engagement of the set-up carriage with the racks when the main cam shaft cycles past the hold-up position.

The set-up carriage escapement program slide (#5) operates the set-up carriage escapement link. The escapement link operates either the escapement pawl (with three or more decimals set) or the alternate release arm (with less than three decimals set). The alternate release arm disables the hold-up latch thru the direct action of the program feed movement and the set-up carriage is not escaped to align with the decimal setting.... The escapement pawl does not disable the hold-up latch. It simply releases the set-up carriage which escapes to the left until the decimal stop arm (attached to the decimal carriage which was coupled to the set-up carriage thru the action of the decimal bail) contacts a stop on the multiplier decimal stop shaft. The stop shaft then moves slightly to the left with the set-up carriage. The left end of the stop shaft operates the hold-up release bell crank, which raises the hold-up latch. This arrangement insures that the set-up carriage escapement to its decimally aligned position will be completed before the hold-up is released to continue the cycle and engage the set-up carriage with the racks.

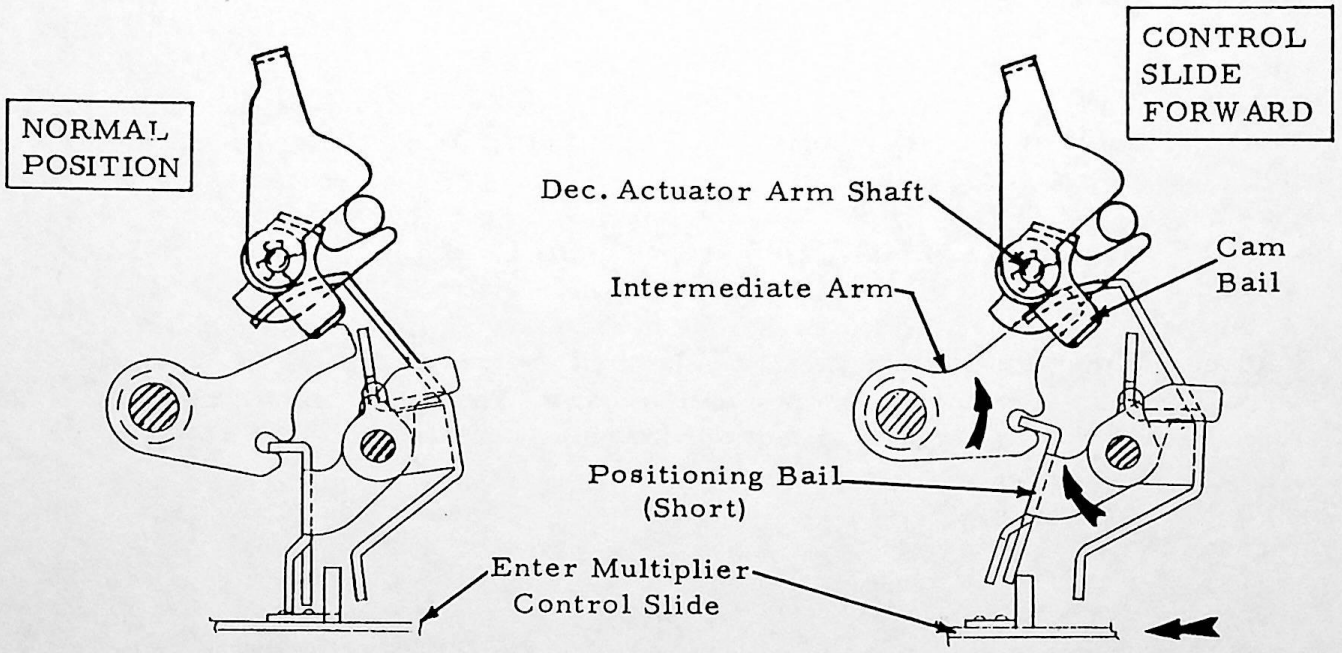
The set-up carriage return program slide (#7) pushes the non-repeat bail into alignment with the lower end of the front pulley arm. This will result in the set-up carriage being returned to the right near the end of the cycle (See pages IV-C-17 and 18 for more details)... unless the squaring key was also used (page IV-H-2). This program slide also pivots the decimal bail shift lever, which moves the decimal bail to the right, (see page IV-E-2). When the bail is moved to the right, one of its slots aligns under the active keystem so that the bail can then be unlatched and restored to its normal radial position even though the key is held down. The bail is unlatched by the carriage return cable drum action. (See Page IV-C-19)

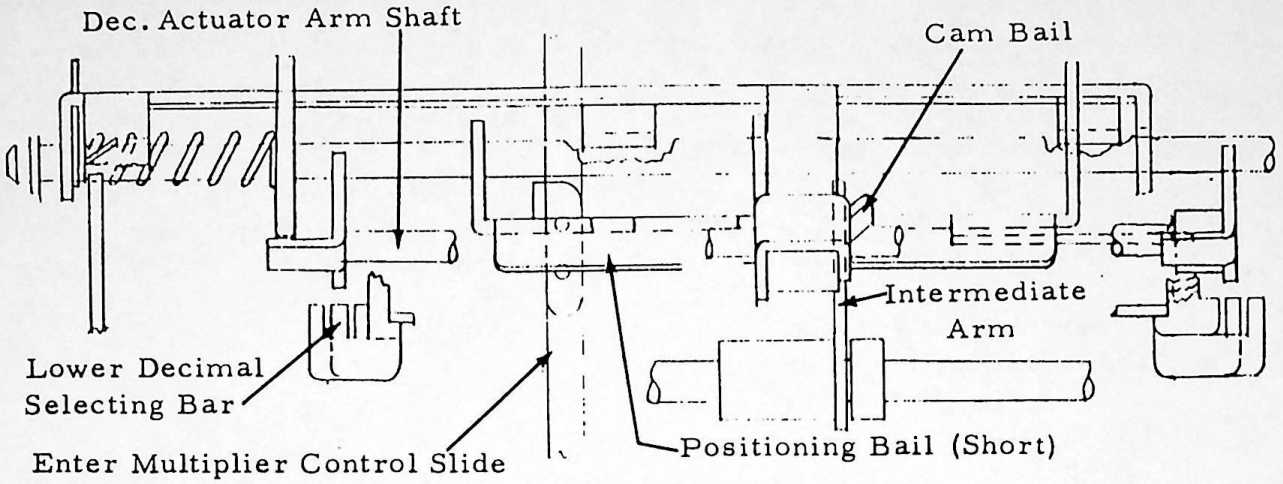
Enter Multiplier Program Slide (#8)

The Enter Multiplier program slide (#8), thru its bell crank, pulls the enter multiplier control slide forward. The forward movement of the enter multiplier control slide does two things....It raises the enter multiplier control bail and pivots the positioning bail for the lower decimal selecting bar. The raising of the enter multiplier control bail raises the rear latch on the #1 operating slide.



The pivoting of the positioning bail (short bail) for the lower decimal selecting bar raises the intermediate arm between the positioning bail and the cam bail on the decimal actuator arm shaft. As the intermediate arm raises, it contacts the cam surface on the cam bail...moving the cam bail and the decimal actuator arm shaft to the half right position where the actuator arms are aligned to select the lower decimal selecting bar.

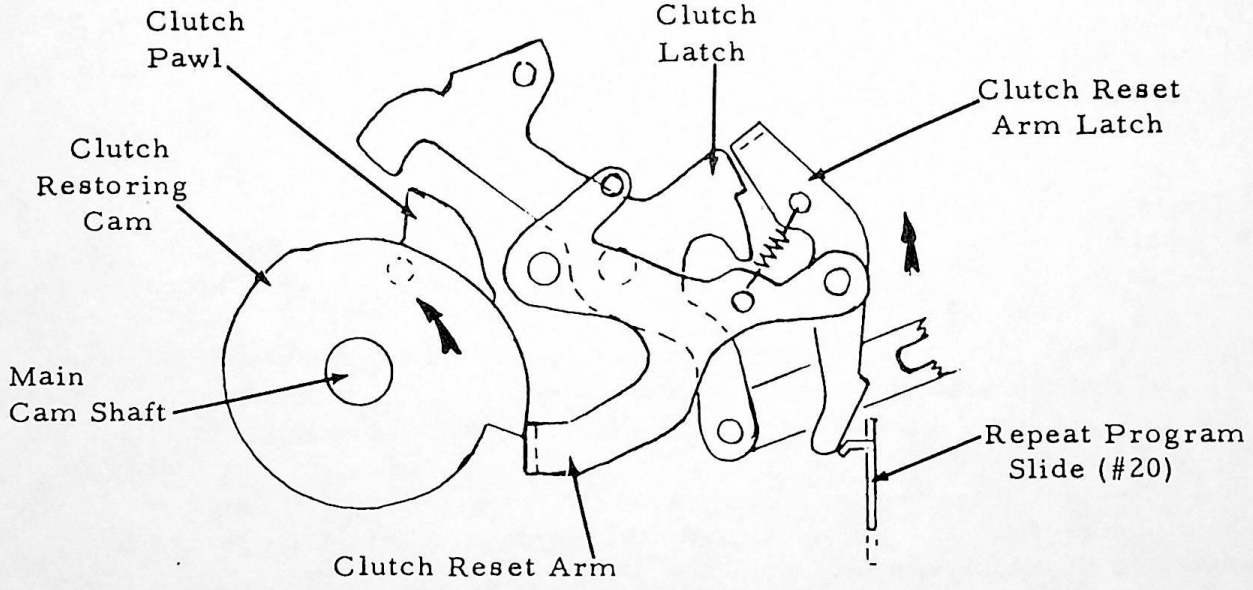




The position of the decimal selecting slide on the lower decimal selecting bar is controlled by the left decimal knob....Since this lower decimal selecting bar is selected on the enter multiplier cycle of the mult. program and also on the quotient cycle of a division program (as will be described later)...the left decimal knob then, controls the decimal position in all printed amounts that are entered into or removed from the multiplier/quotient gears.

Repeat Program Slide (#20)

The repeat program slide (#20) is operated on multiple cycle programs to permit the main cam shaft to cycle thru its "home" position without stopping.



When this slide is pushed to the left on the program feed stroke, the lug on its left end positions in front of the clutch reset arm latch. Therefore, near the end of the cycle, when the clutch restoring cam pivots the clutch reset arm, the repeat program slide will prevent the clutch reset arm latch from engaging the restoring step of the clutch latch....The clutch latch will not be restored...it will not engage the clutch pawl...and the main cam shaft will continue into the second cycle without interruption.

Summary of the program feed stroke:

a. Program slide #4 activates drive arm for engaging set-up carriage with racks.

b. Program slide #5 escapes set-up carriage or operates alternate hold-up release arm... depending on decimal setting.

c. Program slide #7 positions non-repeat bail for carriage return and shifts decimal bail to the right.

d. Program slide #8 positions decimal actuator arm shaft to select lower decimal selecting bar and activates latch to engage multiplier gears with racks and raise sensing bails.

e. Program slide #20 engages clutch reset arm latch to disable clutch restoring mechanism.

As the main cam shaft cycles thru the hold-up position on the first cycle, the roller on the hold-up latch operating lever is cammed out of the cam notch in the hub of the carriage return/platen space cam. The upper end of this lever pivots the hold-up bell crank which pushes the multiplier decimal stop shaft slightly to the right. The set-up carriage, which is stopped at one of the multiplier stops, moves slightly to the right with the stop shaft. This movement aligns the set-up carriage set-up gears laterally for engagement with the racks. The movement of the mutliplier decimal stop shaft to the right also moves the other two decimal stop shafts with it, since the three stop shafts are tied together by a connecting bracket near their left ends. This movement of the other two stop shafts is incidental in the case of a multiplier entry, however it is required on other operations to align the set-up carriage when the set-up carriage is stopped by one of these other stop shafts.

With the set-up carriage now properly aligned with the racks, the total lobe of the total/sub-total cam rocks its cam follower. The cam follower drives the #2 operating slide forward... engaging the set-up carriage with the racks.

The rack restoring cam follower springs now pivot the rack restoring cam followers in a clockwise direction (as viewed from the right side) as the follower rollers move into the low section of the rack restoring cams. This pulls the rack restoring bar to the rear.... The racks representing the multiplier figure are pulled toward the rear by their springs. They will stop individually when they have turned their set-up dials to zero... having transferred the amount to the print wheels.

As the racks move from restored position they cam down the decimal activator bail and, while the rack restoring bar is moving to the rear, the decimal cam rocks its cam follower... engaging the lower decimal selecting bar slide with the decimal control fingers at the selected decimal position.

Also, while the rack restoring bar is moving to the rear, the print hammer cam rocks its cam follower. The cam follower pivots the hammer restoring arms, the hammer latch raising bail and the hammer release bail. The hammer restoring arms pivot the hammer restoring bar and ribbon raising bail and move the ribbon feed pawls to the rear.

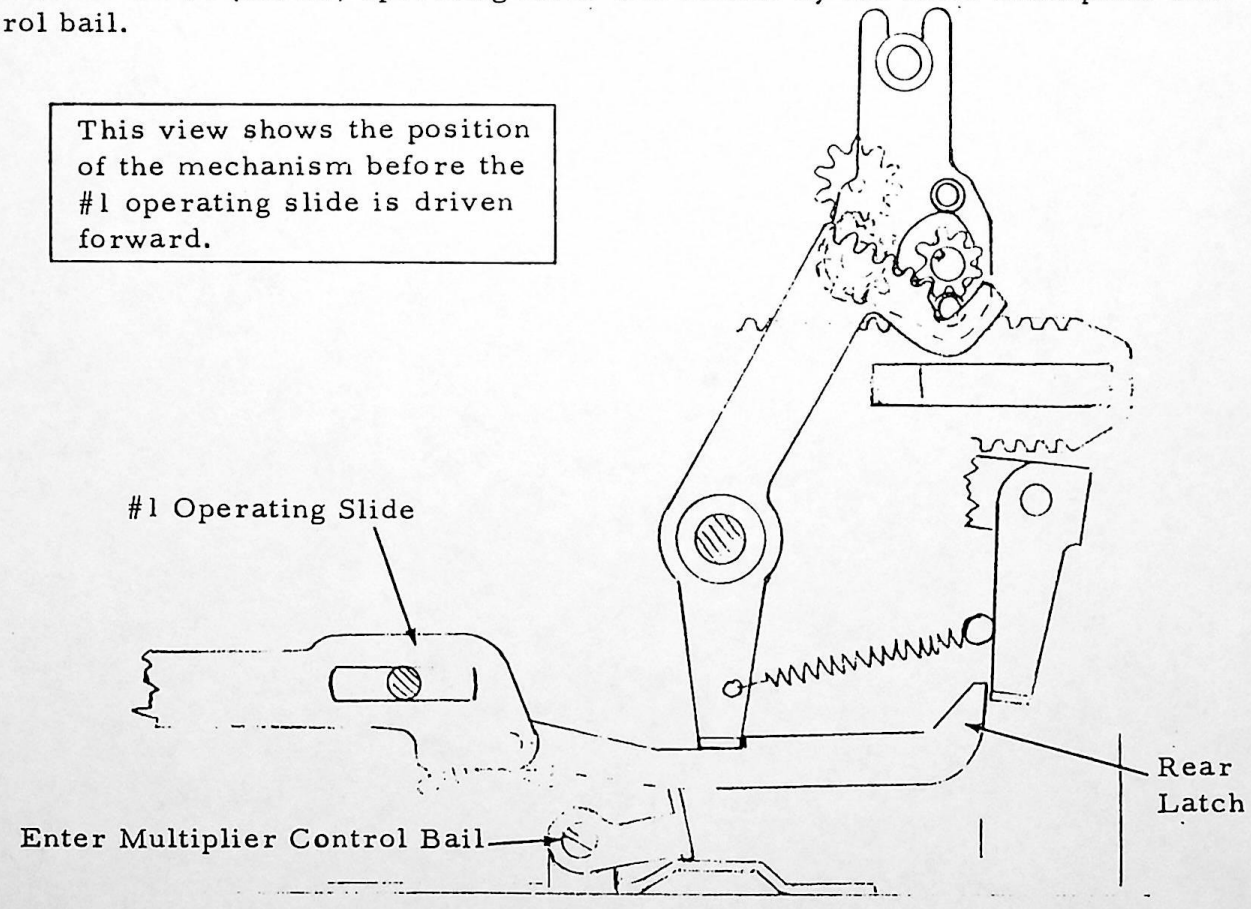
Just as the rack restoring bar reaches the end of its rearward travel, the rack aligner cam starts to drive the aligner pawls into engagement with the ratchet teeth on the underside of the racks. At the same time, the hammer release bail releases the print hammers which are "fired" against the platen by their springs... printing the multiplier figure with the multiplication (=) symbol.

As the racks are engaged by the aligner pawls, the total/sub-total cam follower spring pivots the cam follower as its roller moves down into the low section of the total lobe. This restores the #2 operating slide to the rear... which releases the set-up carriage from engagement with the racks.

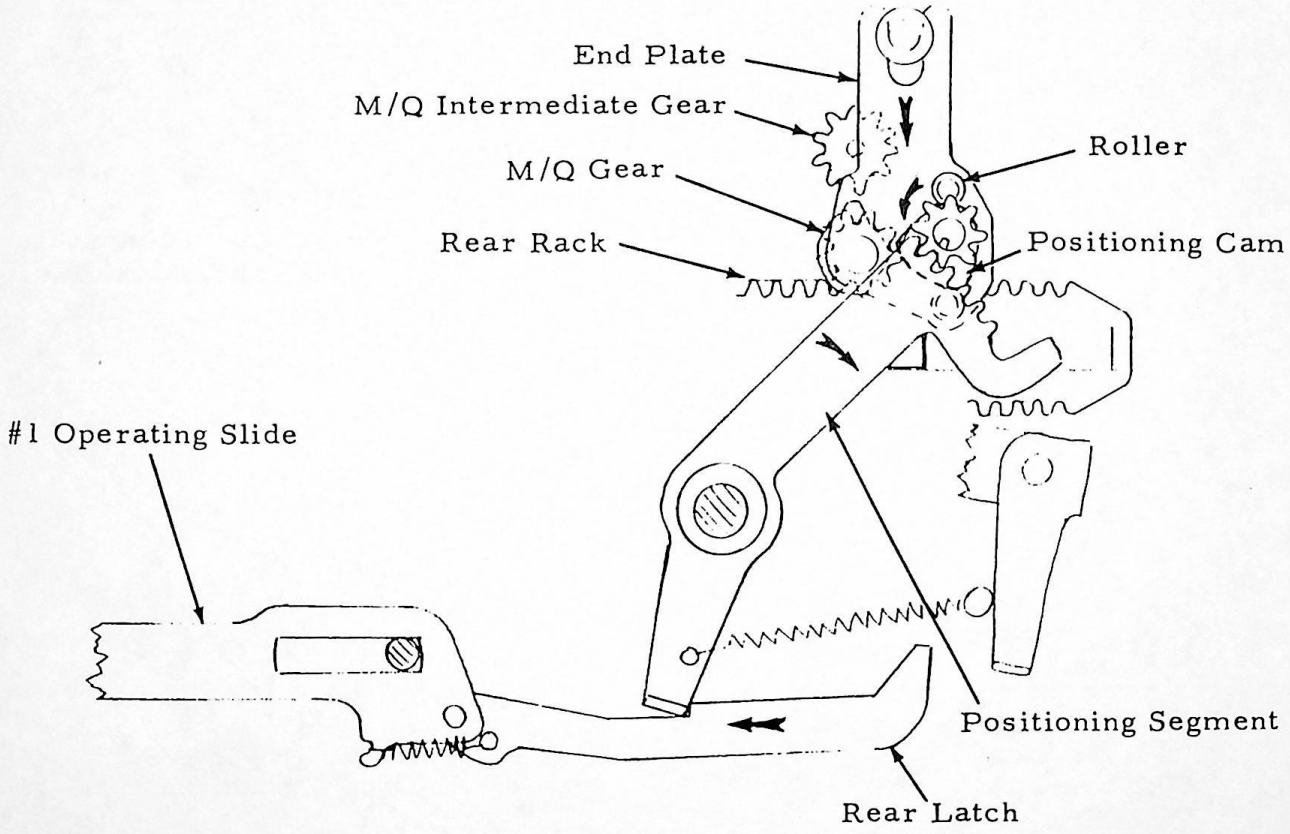
With the racks fully aligned, the print hammer cam pivots the hammer restoring bar... pulling the print wheels away from the platen to a partially restored position.

As the set-up carriage is being disengaged and the hammers are being partially restored, the rack restoring bar dwells in its rearmost position and the rack aligner dwells in the aligned position.... During this time the drive cam for the #1 and #3 operating slides rocks the slides forward.... Without its latch raised, the #3 (outside) operating slide has no function. However, the rear latch on the #1 (inside) operating slide was raised by the enter multiplier control bail.

This view shows the position of the mechanism before the #1 operating slide is driven forward.

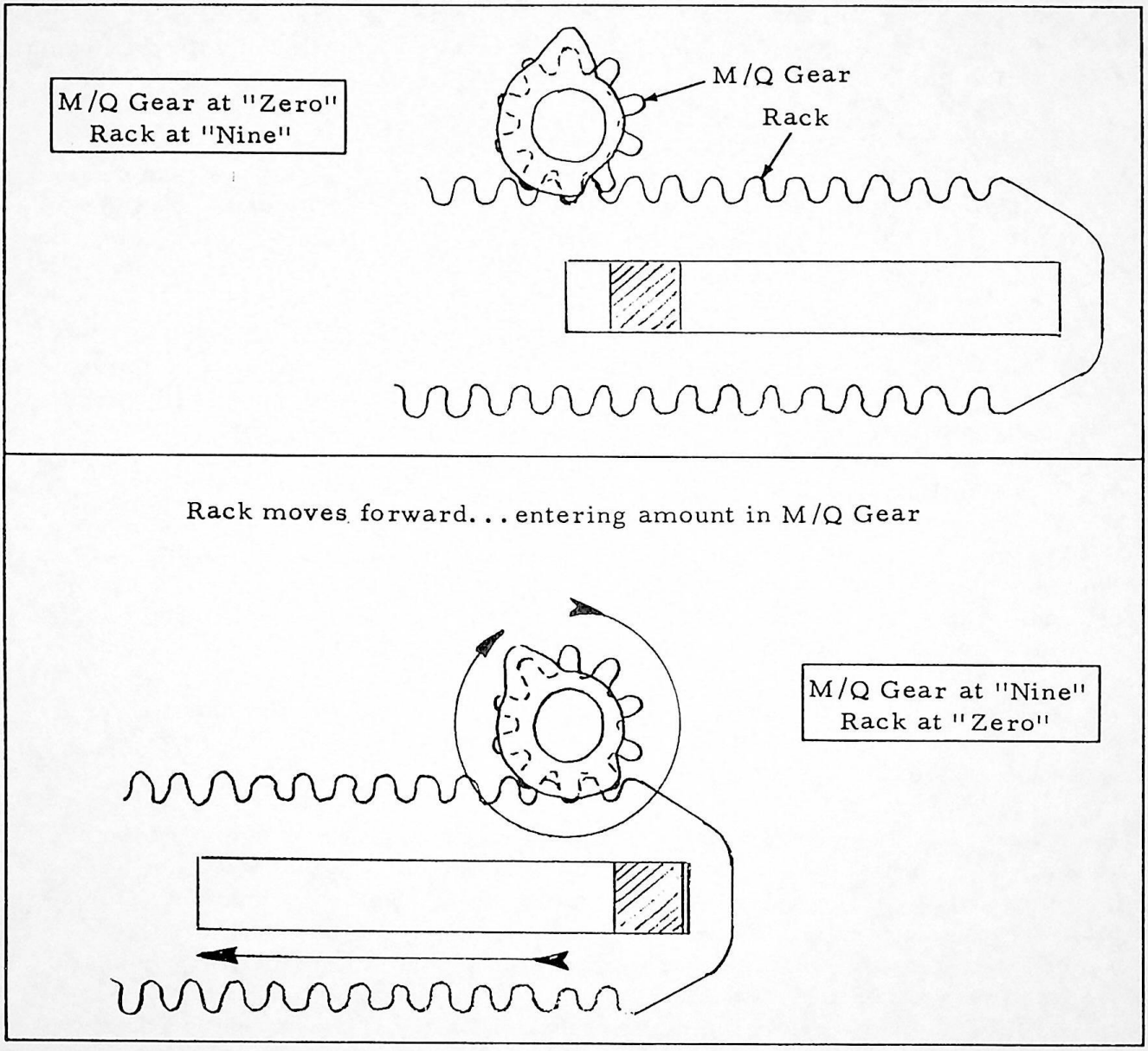


As this raised latch moves forward it engages the lower lug of the positioning segment for the multiplier/quotient gear assembly, rocking the segment in a clockwise direction. The segment turns the gear on the right end of the positioning cam shaft in a counter-clockwise direction. The two positioning cams are "caged" by top and bottom rollers on the right and left end plates of the M/Q gear assembly. The top rollers normally rest just at the edge of the high section of the cam. The counter-clockwise movement of the cams moves the high section around to the bottom roller, driving the end plates down. The end plates carry the M/Q gear shaft and the downward movement meshes the M/Q gears with the rear racks.



While the M/Q gears are being moved into mesh, the set-up carriage return/platen space cam starts to pivot its cam follower. The pivoting is a gradual action and will continue thru most of the second half of this first cycle.

As the M/Q gears move fully into mesh, the drive cam for operating slides #1 and #3 will dwell, holding the gears in mesh as the rack restoring cam moves the rack restoring bar forward. The aligner pawls remain engaged as the individual racks are picked up at their displaced positions and restored by the forward moving rack restoring bar. This forward restoring of the racks enters the multiplier figure in the M/Q gears. That is... a rack will turn a M/Q gear a number of teeth away from its zero position equivalent to the multiplier digit in that column.



The restoring of the racks releases the decimal activator bail and the bail is lifted by its spring. This raises the drive link on the decimal cam follower out of engagement with the right actuator arm on the decimal actuator arm shaft. The restoring springs at each end of the lower decimal selecting bar then restore the bar which pulls the prongs of its decimal selecting slide out of engagement with the decimal control fingers. The restoring of the decimal selecting bar also pushes the actuator arms to the rear.

Meanwhile, the decimal cam follower, pulled by its spring, starts to move into the low section of the decimal cam. This pushes the drive link to the rear...toward its neutral position. Just before the link reaches neutral, its lower extension contacts the lug of the right actuator arm...moving the actuator arms slightly further toward the rear than they had been pushed by the restoring of the decimal selecting bar. This provides a clearance between the selecting bars and actuator arms which permits the arms to move laterally. (At this stage, however, the actuator arms remain aligned with the lower selecting bar).

The action of the print hammer cam had pulled the print wheels away from the platen immediately after the figure printed....The print hammers then dwelled in a partially restored position as the rack restoring movement entered the multiplier in the M/Q gears and turned the print wheels back to their zero positions. This rack restoring movement also "re-loaded" the rack springs.

With racks fully restored, the restoring of the print hammers is resumed and will continue until the end of the cycle. The return movement of the hammer restoring arms will also pivot the ribbon raising bail...moving the ribbon down to its neutral position and pushing the ribbon feed pawls forward. The "active" ribbon feed pawl will engage the feed ratchet gear on the ribbon post and advance the ribbon.

This print hammer restoring will also "re-load" the print hammer springs. Note that the two potentially "heavy load" functions of restoring the racks and restoring the hammers are timed to occur separately and the full restoring action is spread out over the entire second half of the cycle.

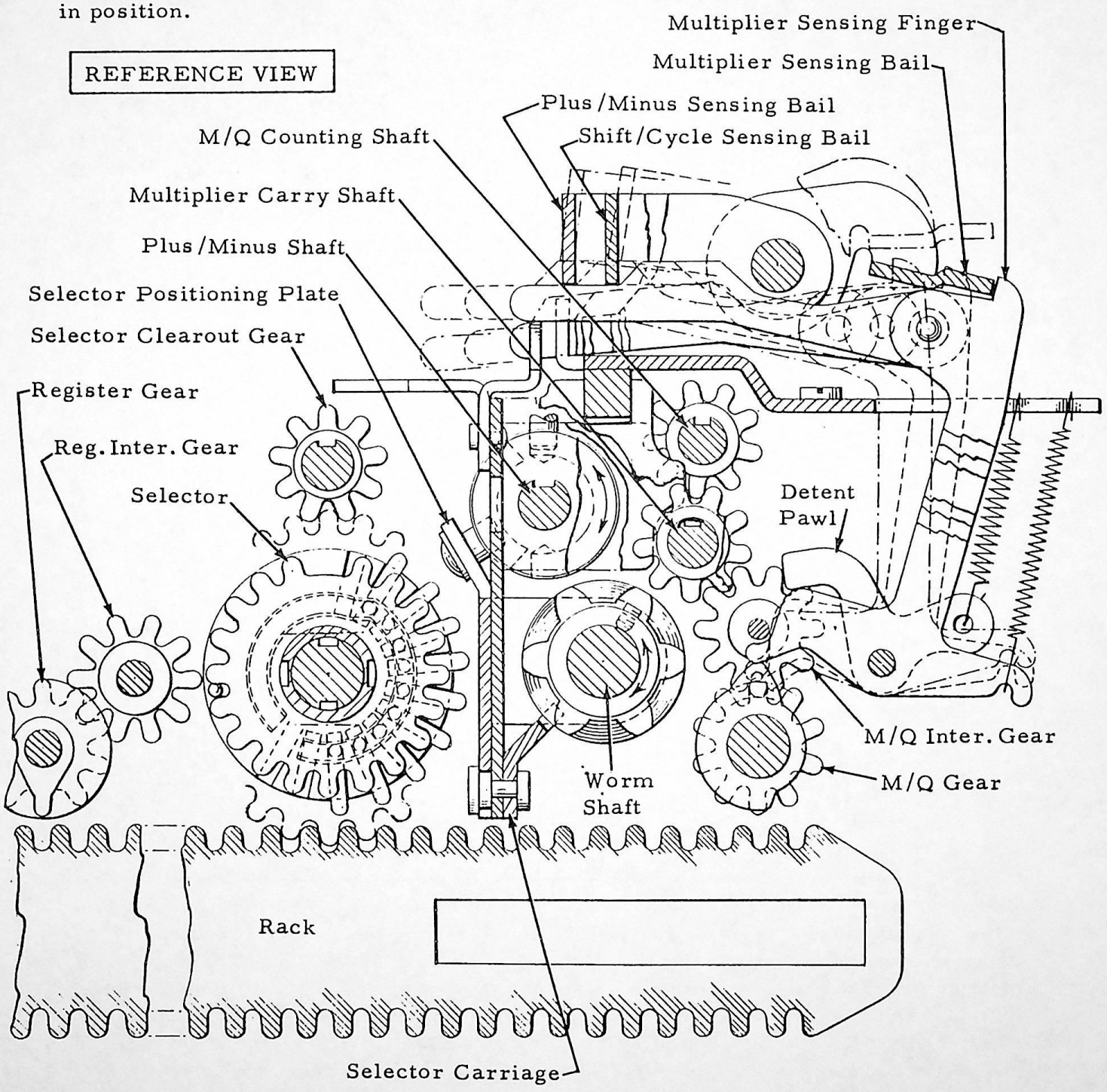
While it is returning the hammer restoring arms to neutral, the hammer restoring cam follower will also lower the hammer latch raising bail to its neutral position.

The hammer release bail, however, is not neutralized gradually by the cam action. The release bail will rest on top of the hammers that were not fired (hammers still held by their hammer latches). As the restoring arms pivot toward restored position the operating stud on the right restoring arm for the hammer release bail link just moves down in the slot of the link. When the latch "steps" on top of the hammers are restored from under the release bail at the end of the restoring movement, the bail will then be pulled down by its spring into its normal (hammer blocking) position.

While the print hammers are being restored, the rack aligner cam disengages the rack aligner pawls from the ratchet teeth of the racks and returns the aligner to its neutral position.

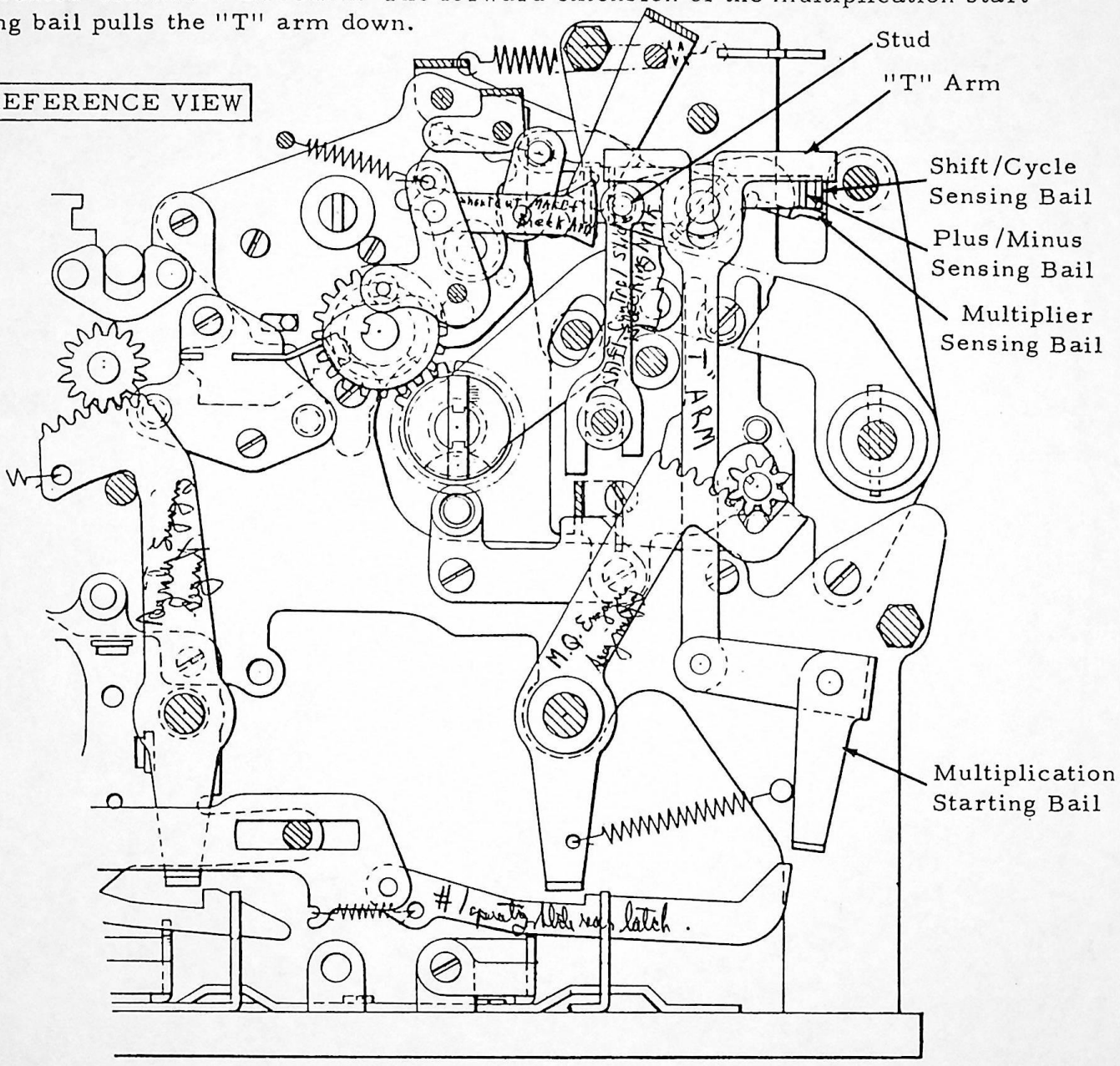
At the same time, the drive cam for the #1 and #3 operating slides pushes the slides to the rear. This releases the latch from the positioning segment for the M/Q gear assembly and the segment is restored by its spring... raising the M/Q gears up out of mesh with the racks to their normal position. Note: In normal position, the M/Q gears are meshed with their intermediate gears and the intermediate gears are detented by spring loaded pawls to hold the gears in position.

REFERENCE VIEW



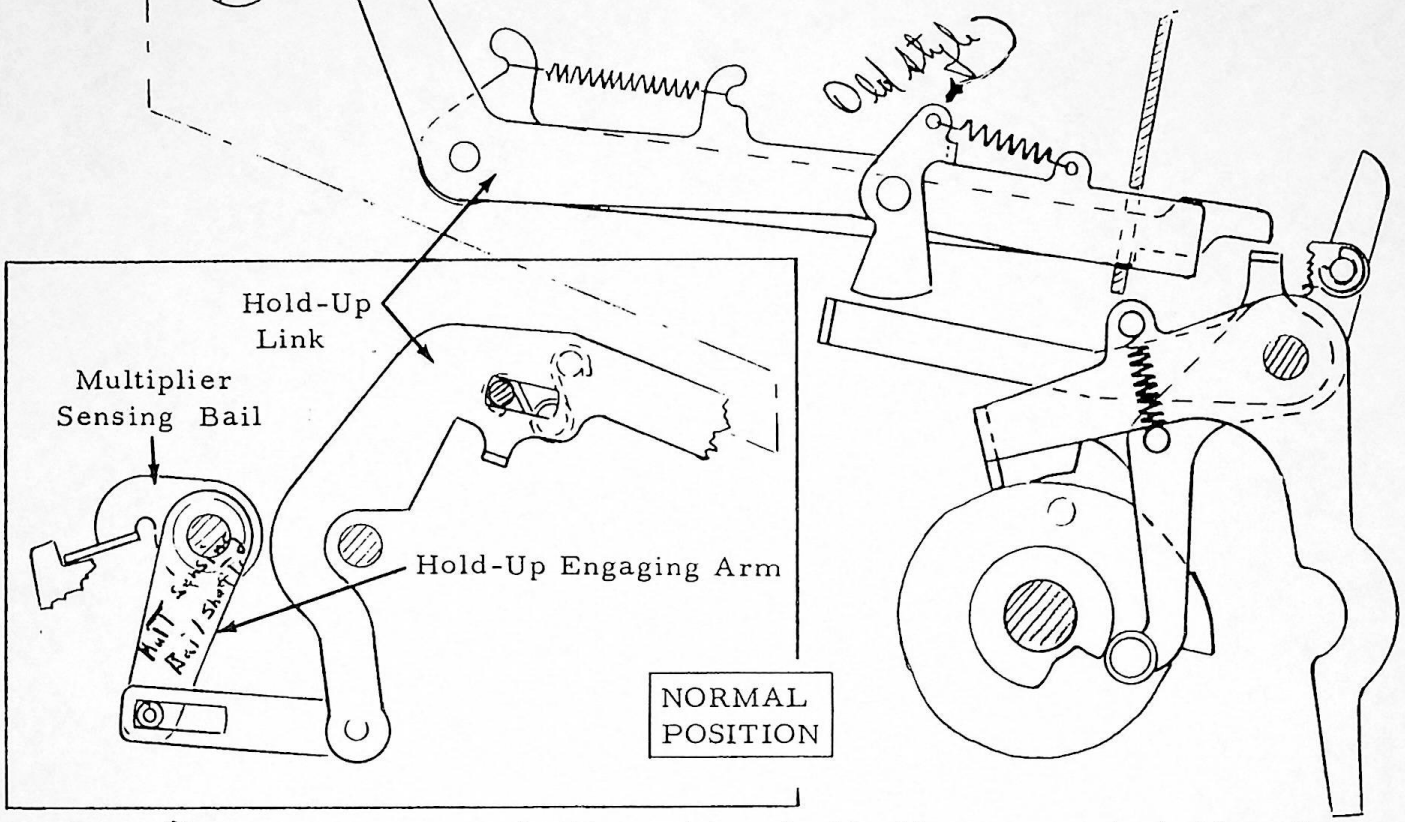
The rearward movement of the #1 and #3 operating slides does not stop at their neutral position...the slides continue moving to the rear. The rear latch on the #1 slide is still held in the raised position by the enter multiplier control bail. As the #1 slide moves past its neutral position the rear latch contacts the lower extension of the multiplication starting bail...pivoting the bail in a counter-clockwise direction. The forward extension of the multiplication starting bail pulls the "T" arm down.

REFERENCE VIEW

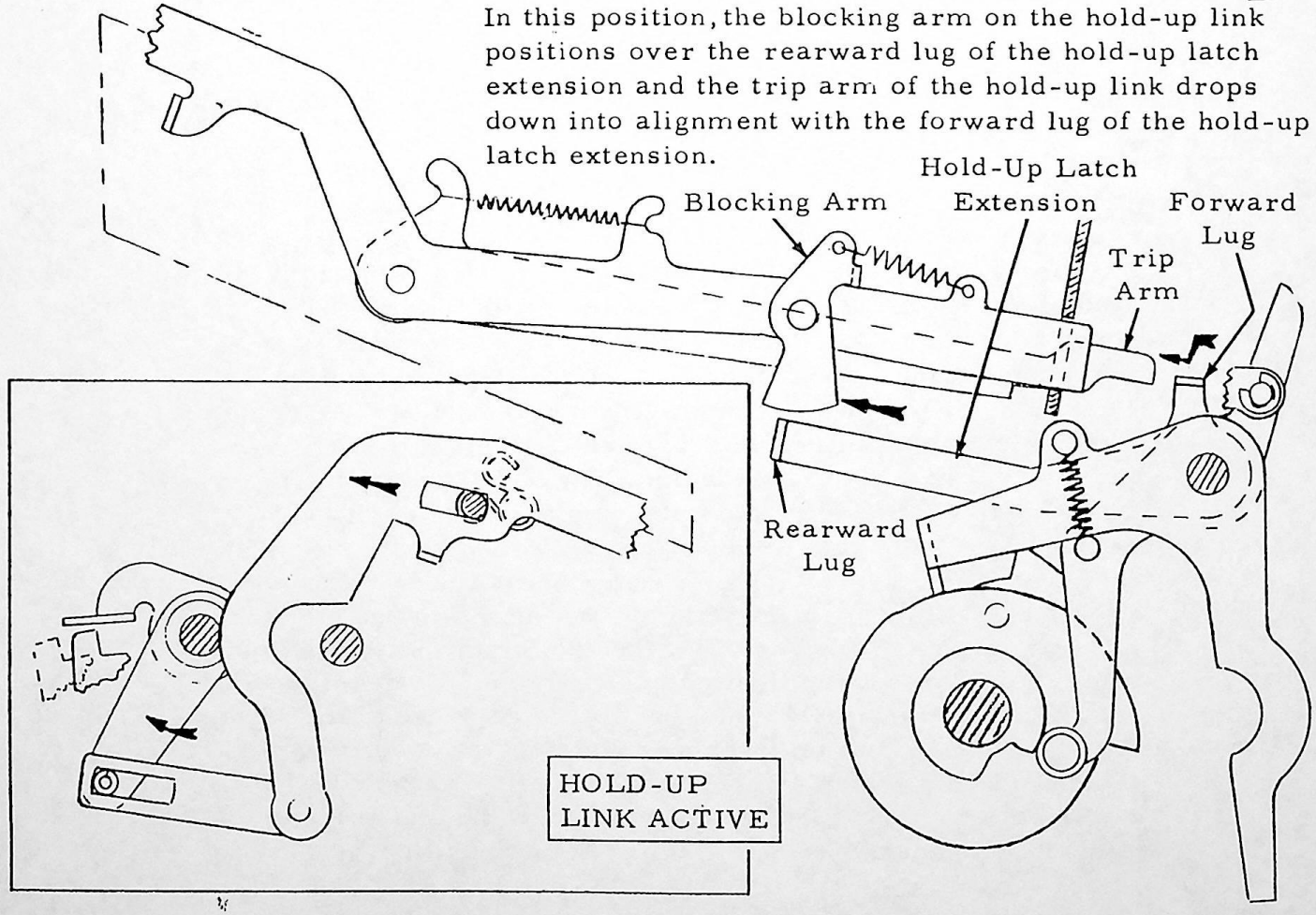


The downward movement of the "T" arm pivots the three sensing bails, raising their sensing surfaces up so that the multiplier sensing fingers can be pivoted by their springs to engage the sensing cams on the M/Q gears. (Note: Only the M/Q gears that have been displaced from zero position will permit their sensing fingers to pivot since the sensing fingers for those gears at "zero" are already resting on the high point of their sensing cams). In raising the sensing bails, the rearward "leg" of the "T" arm contacts the rear lugs of the plus/minus (short cut) sensing bail and the shift/cycle sensing bail pivoting them in a clockwise direction....The forward "leg" of the "T" arm contacts the stud of the right end arm on the multiplier sensing bail shaft pivoting the multiplier sensing bail in a counterclockwise direction.

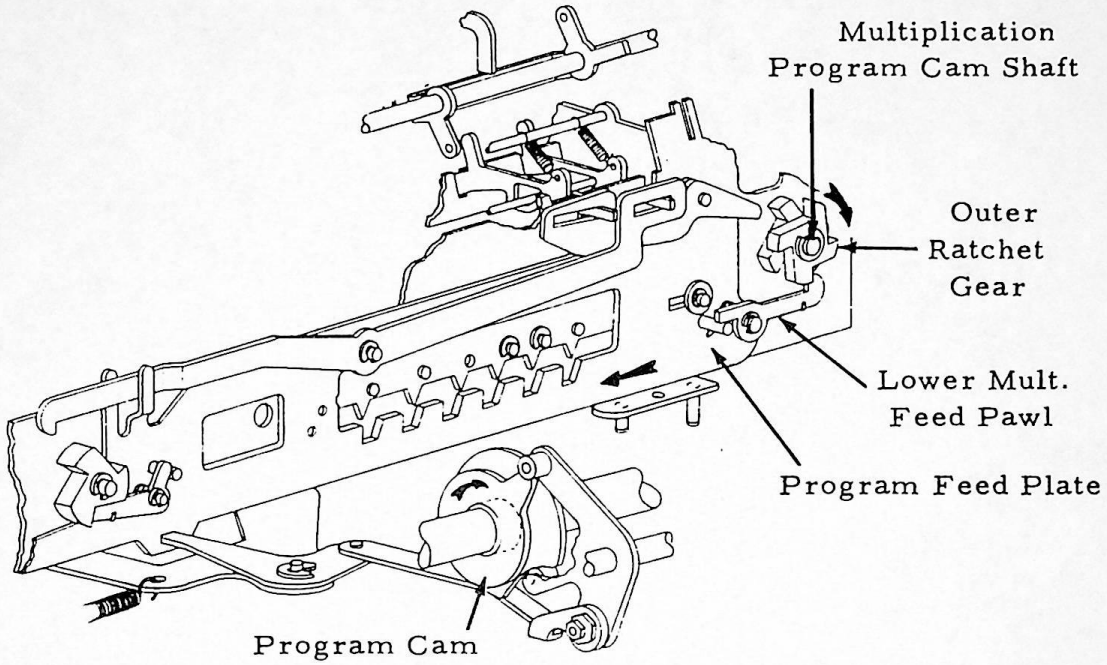
The hold-up engaging arm is on the left end of the multiplier sensing bail shaft and the pivoting of the shaft pulls the hold-up link to the rear.



In this position, the blocking arm on the hold-up link positions over the rearward lug of the hold-up latch extension and the trip arm of the hold-up link drops down into alignment with the forward lug of the hold-up latch extension.



The program cam now starts to return the program feed plate to the right, and the lower mult. feed pawl engages the outer feed ratchet gear on the rear end of the multiplication program cam shaft. This will index the shaft to its second active detent position.



While the program feed plate is being returned to the right the carriage return/ platen space cam follower reaches the high point of the cam.

This is the gradual pivoting action that began earlier in the cycle when the M/Q gears were being meshed with the racks. As this cam follower pivoted, the end of its slot contacted the stud of the rear pulley arm (the point at which this occures depends upon how far the set-up carriage had moved to the left when setting-up and decimally aligning the multiplier). The pulley arm was then driven rearward...pulling the cable. The cable pivoted the cable drum and decimal bail latch release arm...releasing the decimal bail. The release arm stud contacted the side frame, stopping the pivoting of the release arm and cable drum. The cable then started to pivot the front pulley arm which immediately limited on the non-repeat bail (which was activated by the set-up carriage return program slide (#7)). The cable then pulled the rear positioning slide to the left which, thru its connecting pinion gear, drove the front positioning slide and the set-up carriage to the right. Also, while this cam follower was pivoting, it pulled down the platen feed link which pivoted the feed bail. The feed bail pushed the feed pawl into engagement with the platen feed ratchet gear advancing it to its next detent position.

With the platen thus spaced and the set-up carriage fully restored to the right, the cam follower drops off the high point of the cam and is pulled by its restoring spring down into the low section of the cam...to its neutral position. This movement also lifts the platen feed link, restoring the feed bail and feed pawl to neutral.

Also...near the end of the program feed plate restoring movement...the drive cam for the #1 and #3 operating slides rocks its cam follower...pulling the slides forward to their neutral (middle) position. The rear latch on the #1 operating slide releases the multiplication starting bail. The multiplication starting bail, thru the "T" arm, releases the three sensing bails and the sensing bails assume positions relative to the sensing finger positions.

This restoring and the completion of the restoring movement of the program feed plate to the right both occur at the very end of the first cycle.

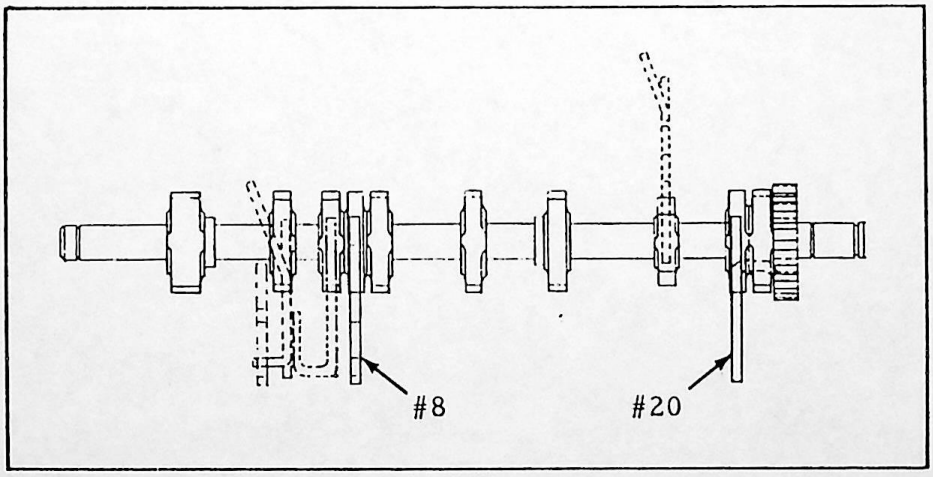
The movement of the mult. program cam shaft to its second detent position releases the following program slides:

Set-up Carriage Engagement (#4)
Set-up Carriage Escapement (#5)
Set-up Carriage Return (#7)

The Multiply/Minus Symbol Slide is also restored to normal position.

NOTE: The decimal key and numeral key lock (Page IV-A-5 and IV-A-6), which was activated by program slide #4, is also restored to its normal position by program slide #4 when this slide is released by the mult. program cam shaft. This "opens" the keyboard to permit the entry of the next figure while the machine is performing the multiplication.

The Enter Multiplier (#8) and Repeat (#20) program slides remain activated to the left.



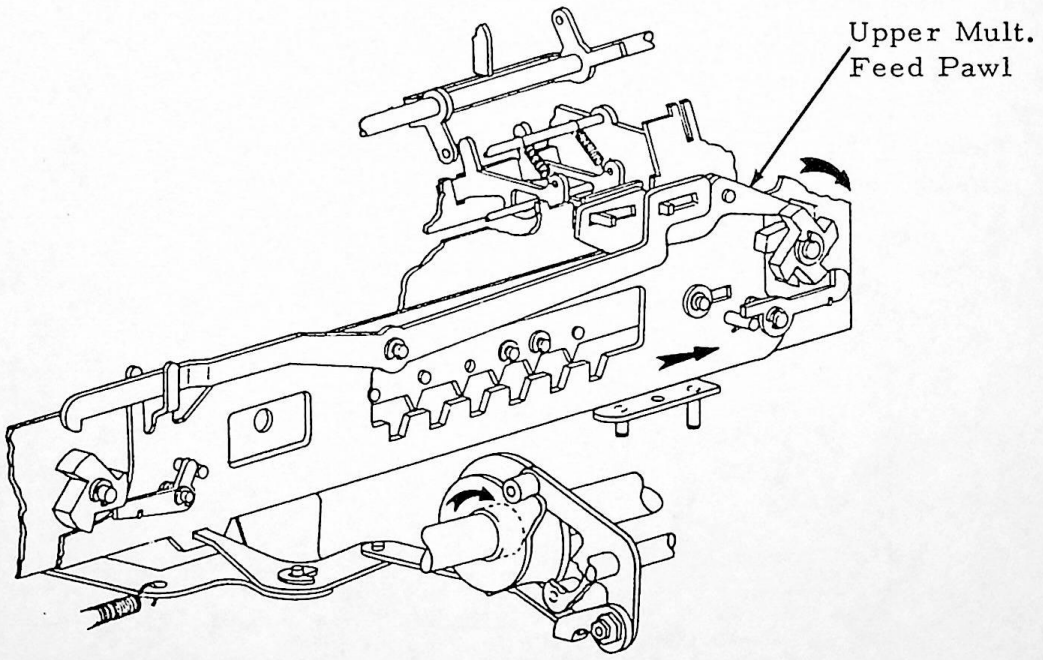
The Enter Multiplier (#8) program slide remains activated to insure that the rear latch on the #1 operating slide did not release the multiplication starting bail at the start of the program feed plate restoring movement.... The restoring of the #1 operating slide...which did release the starting bail...occurred at the end of the program feed plate restoring movement.

Start Second Cycle....

With the repeat program slide (#20) active, the clutch latch was not restored at the end of the first cycle ... the keystem remains down ... and the main cam shaft cycles thru its "home" position and starts the next cycle without interruption.

The keystem holds the keyboard locking bail, the clutch release bail and the multiplier bail activated...and remains in engagement with the displacement lock.... The decimal bail was unlatched and its spring restored it to its neutral radial position during the first cycle and, when the set-up carriage return program slide was released at the end of that cycle, the decimal bail spring pulled the bail to the left. The bail moved left until the left edge of its "active" slot limited against the right side of the depressed multiplication keystem. In moving to the left the decimal bail pivots its shift lever. The bail and shift lever will remain in this partially restored lateral position until the keystem is released at the end of this second cycle.

As the program feed plate is driven to the left by the program cam at the start of the second cycle, the upper mult. feed pawl again engages the inner feed ratchet gear on the multiplication program cam shaft and indexes the shaft to its third active detent position.



As the shaft is indexed, its program cams release the following program slides:

Enter Multiplier (#8)
Repeat (#20)

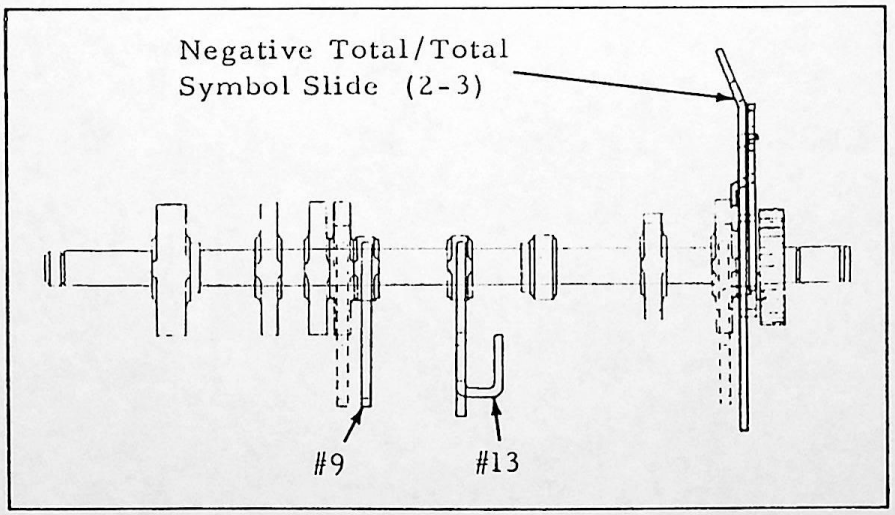
The enter multiplier program slide is restored to the right (neutral position) by its bell-crank spring which pivots the bell crank. This also pushes the enter multiplier control slide to the rear which allows the enter multiplier control bail and the rear latch on the #1 operating slide to lower (by gravity) to their neutral positions. The rearward movement of the enter multiplier control slide also allows the positioning bail (short) for the lower decimal selecting bar to be returned to neutral.

Note: When this short bail pivoted, it also pivoted the long positioning bail (for the middle decimal selecting bar).... While this pivoting is required to disable the selection of the middle decimal selecting bar on quotient transfers, it is not required... merely incidental to the design... on this multiplication function. However, when the positioning bail (short) for the lower decimal selecting bar cammed the decimal actuator arm shaft to the half right position, the movement of the actuator arm shaft also moved the long positioning bail to the right against the tension of its restoring spring.... This movement is required... since the restoring spring pushes the long bail to the left when the enter multiplier control slide releases the short bail. When the long bail is pushed to the left it pulls the decimal actuator arm shaft with it.... The cam bail on the actuator arm shaft cams the intermediate arm down... and the intermediate arm restores the short positioning bail (for the lower decimal selecting bar) to its neutral position.

The repeat program slide (#20) is pulled to the right (neutral position) by its restoring spring which is attached to the bottom plate of the program unit.

In addition to releasing program slides #8 and #20, the indexing of the multiplication program cam shaft to its third active detent position also activates the following program slides:

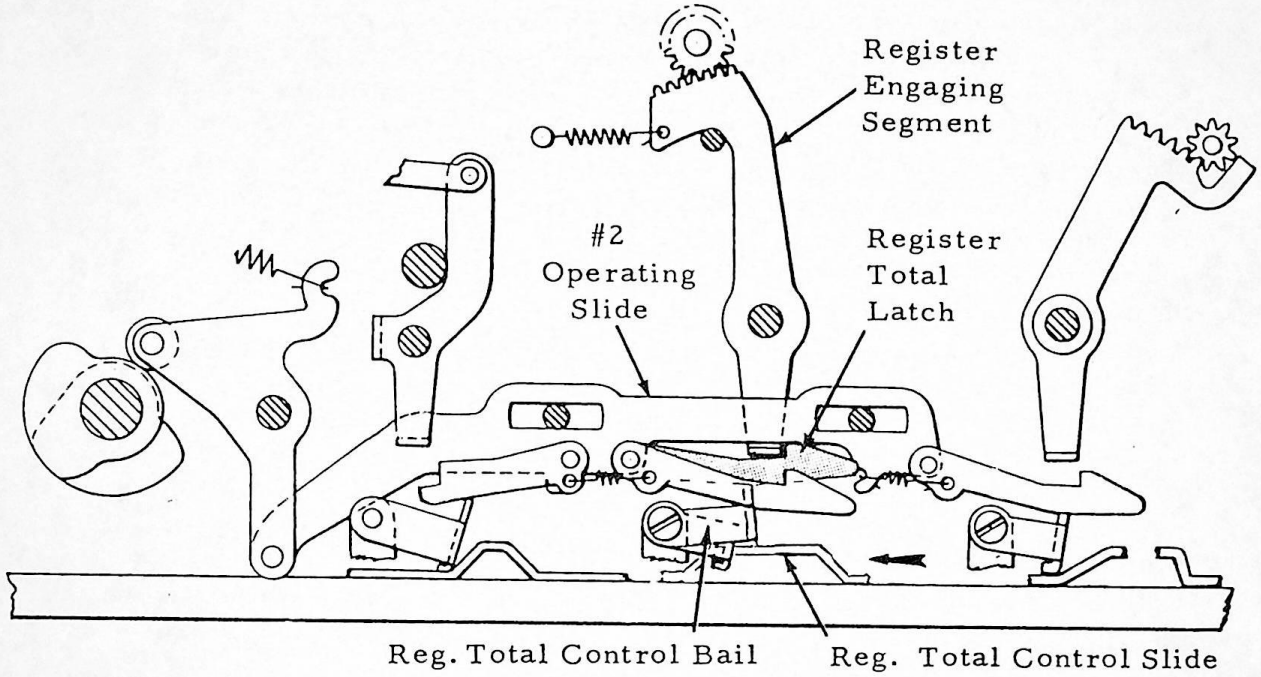
Register Total (#9)
Shift & Cycle Clutch Trip (#13)



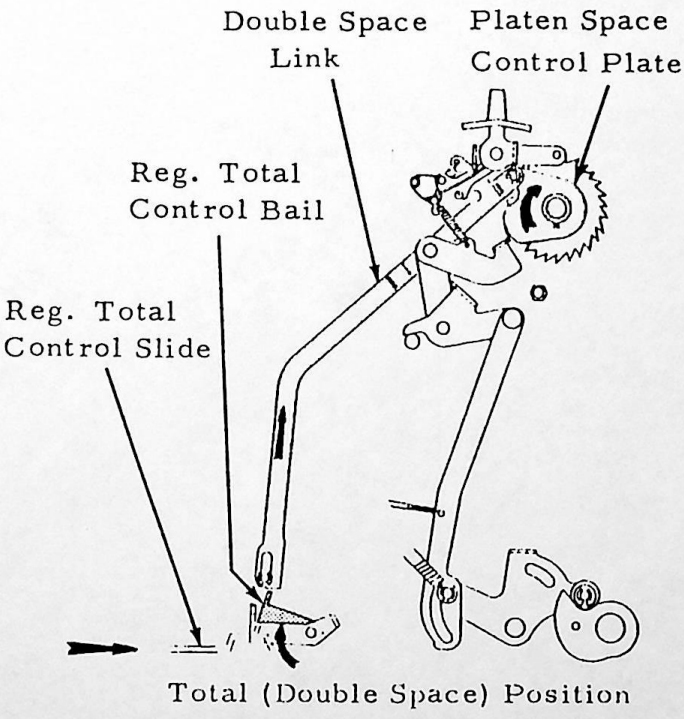
At the same time the negative total/total symbol slide (2-3) is activated to its full right position where its stop lug is aligned in the path of the rearward step of the left symbol rack. This will cause the total symbol to be printed with the product of the multiplication.

Register Total Program Slide (#9)

Movement of the Register Total program slide (#9) to the left pivots a bell crank which pulls the register total control slide forward... raising the register total control bail. The register total control bail raises the register total latch on the #2 operating slide into engagement with the offset lug on the lower end of the register engaging segment.



The register total control bail also has an extension on its left end similar to the extension on the accumulator total control bail. When the register total control bail is raised, the extension raises a link which moves the platen space control plate to double space position.

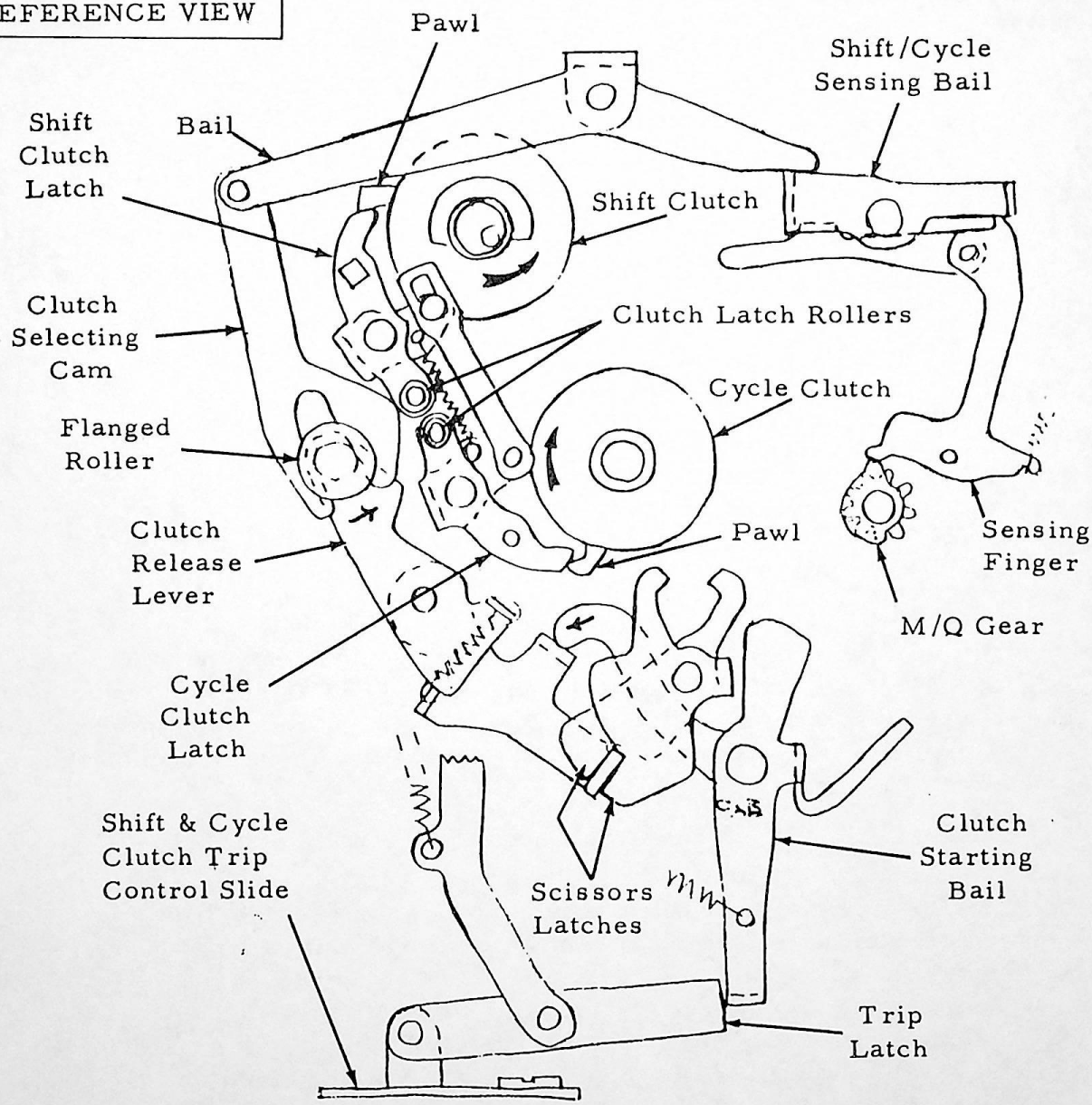


Shift and Cycle Clutch Trip Program Slide (#13)

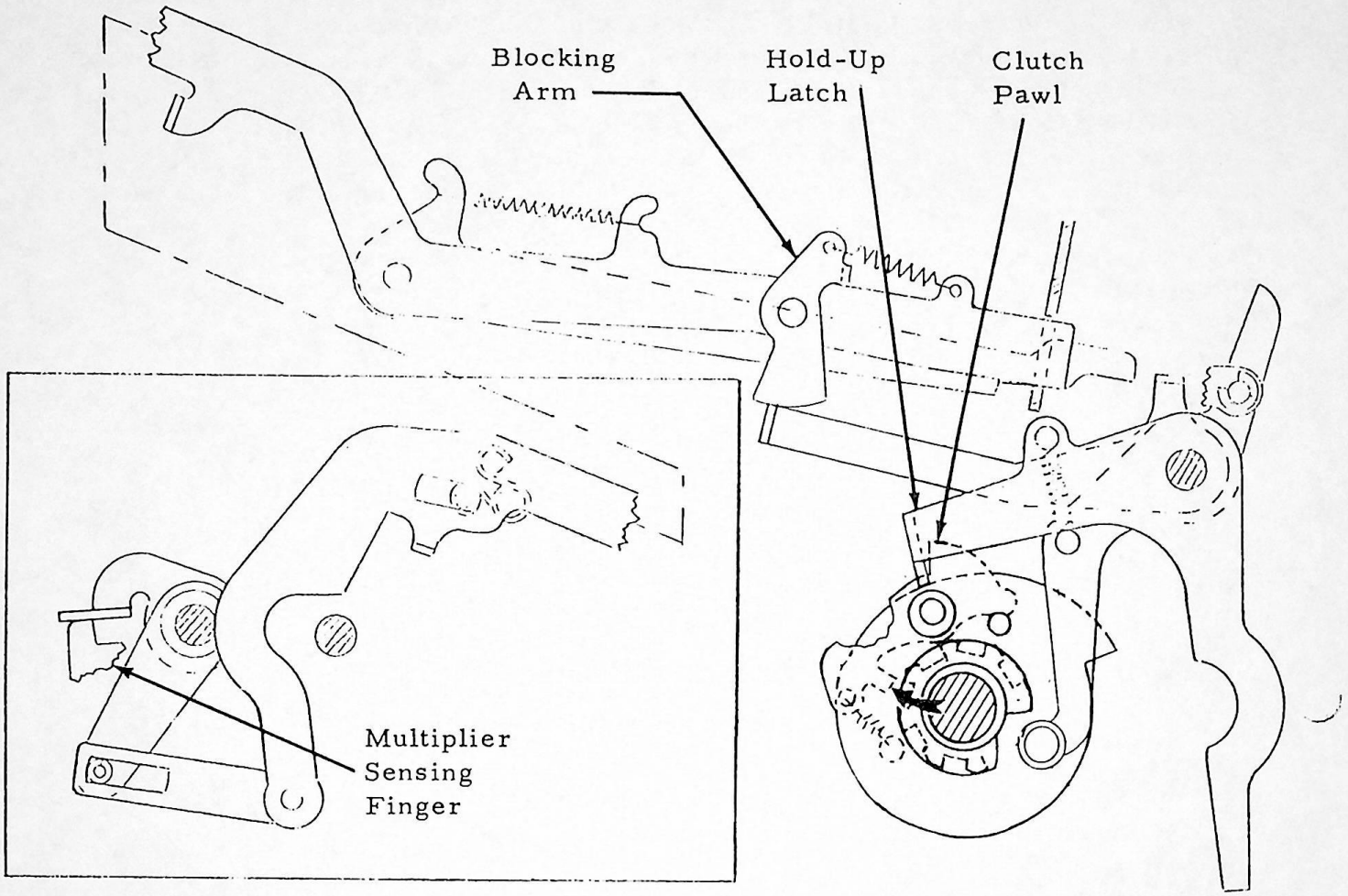
Movement of the Shift & Cycle Clutch Trip program slide (#13) to the left pivots a bell crank which pushes the shift and cycle clutch trip control slide to the rear. A trip latch on the rear end of the shift and cycle clutch trip control slide contacts an offset lug on the lower extension of the clutch starting bail . . . pivoting the bail in a counter-clockwise direction. The forward extension of the clutch starting bail contacts the upper offset lug of the clutch release lever . . . pivoting the lever in a clockwise direction. A flanged roller on the upper end of the clutch release lever is engaged in a slot of the clutch selecting cam and the pivoting of the lever pushes the cam to the rear. The operating surface of the cam engages the roller of either the shift or cycle clutch latch . . . pivoting the latch out of engagement with the clutch pawl. The pawl spring pushes the pawl into engagement with the rotating clutch drive gear and the clutch starts to cycle.

ETBAW

REFERENCE VIEW



At the same time, the main cam shaft clutch pawl contacts the hold-up latch which pivots the pawl out of engagement with its drive gear ... stopping the main cam shaft cycle in hold-up (30°) position.

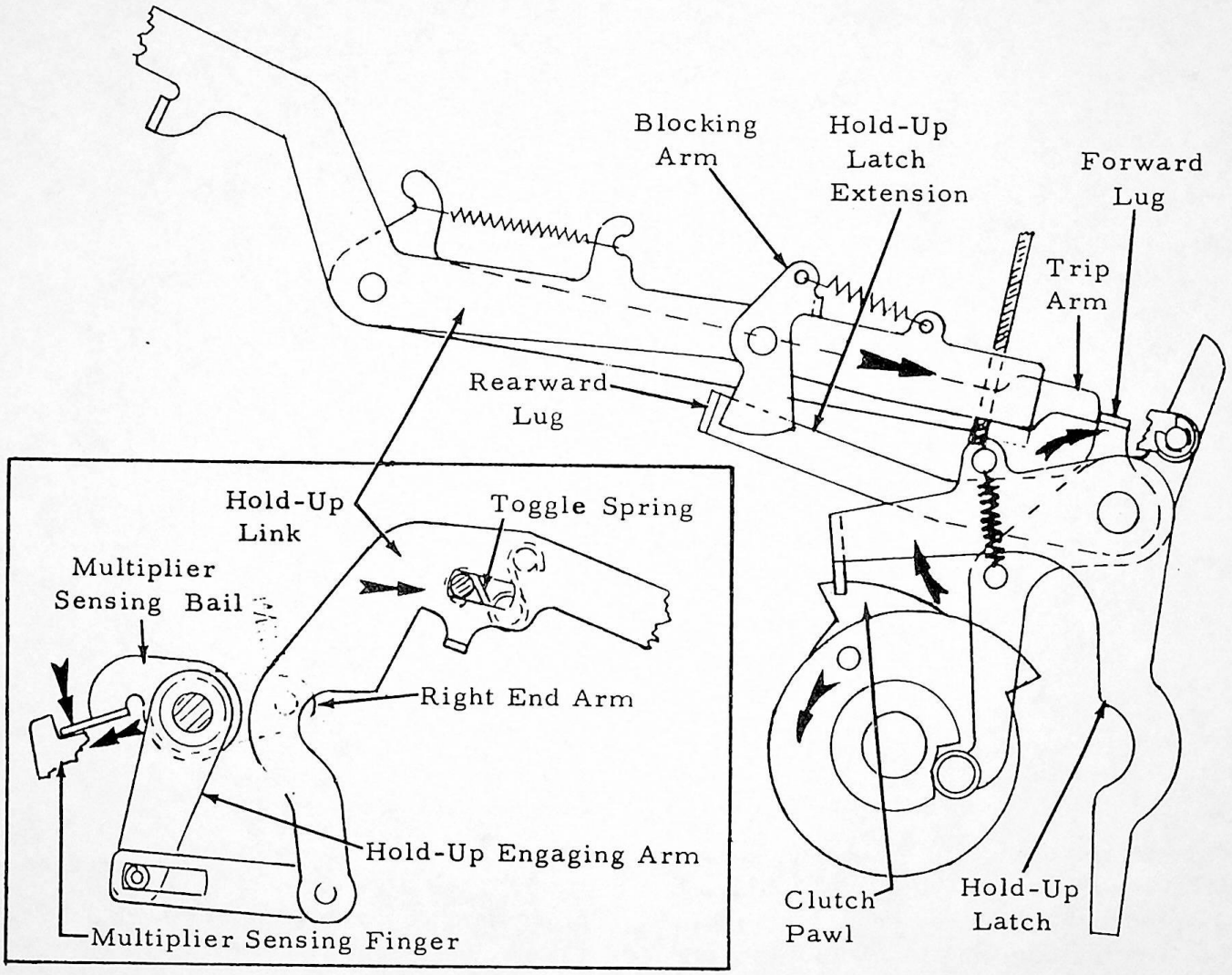


The blocking arm of the hold-up link will prevent release of the hold-up latch as long as any multiplier sensing finger is in active position.

NOTE: Theoretically, with the auxiliary hold-up trip spring properly adjusted (See Page IV-E-15) and no vibration present, the hold-up latch would remain engaged with the clutch pawl. However, the vibrations from high speed cycling would tend to disengage latch... and this is why the blocking arm on the hold-up link is provided.

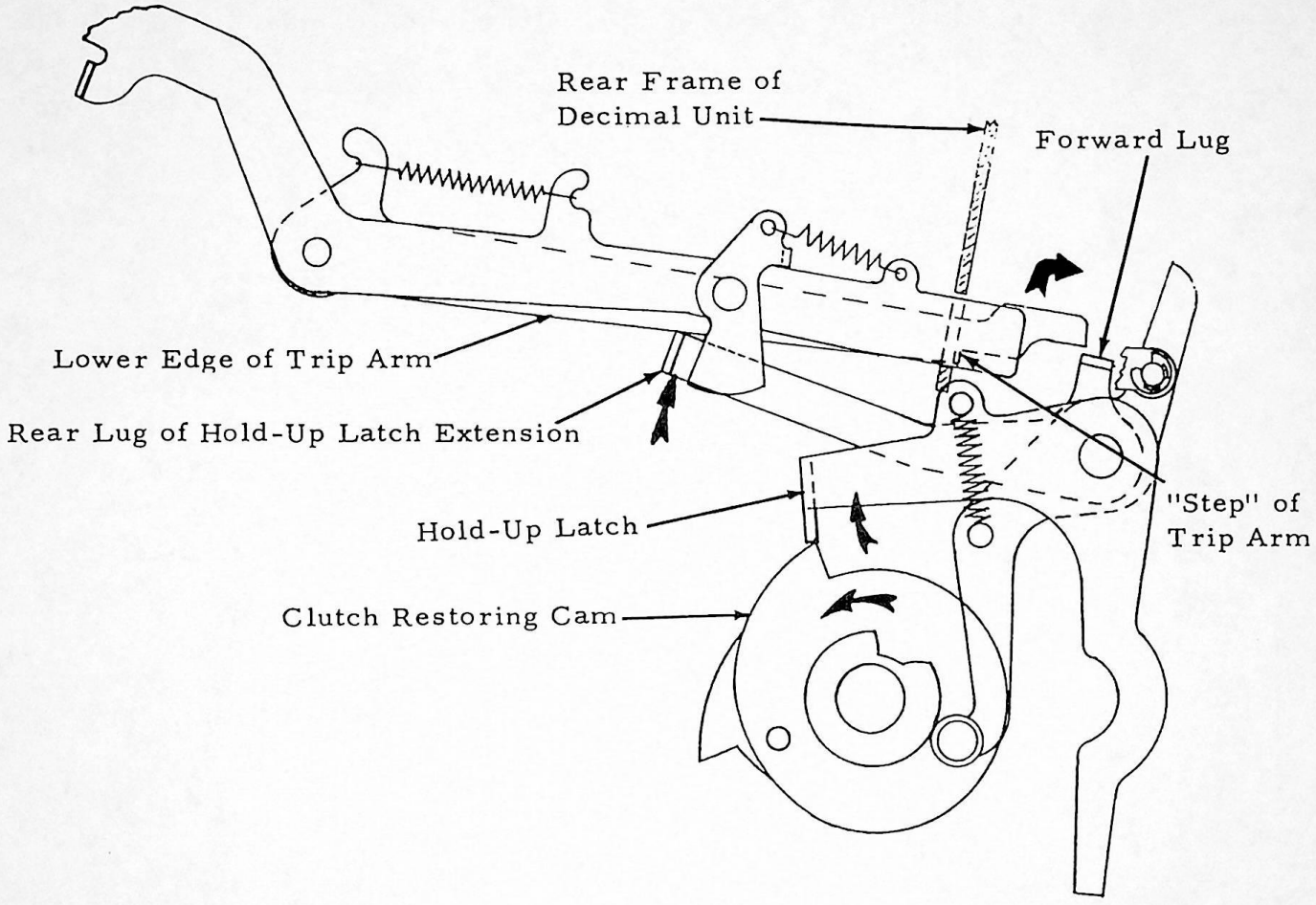
The function of the high-speed calculating mechanism, in performing multiplication, varies according to the figures entered in the selector and multiplier gears .... Therefore, the description of the second main cam shaft cycle will be completed first ... then the function of the multiplication mechanism will be described. Examples of several calculations will be given to explain the variations in mechanical function.

When the last multiplier gear containing a significant digit has been counted to zero, its sensing finger is pivoted out from under the multiplier sensing bail... releasing the bail. The multiplier sensing bail is pivoted in a counter-clockwise direction (as viewed from the left) by its restoring spring (on the stud in the right end arm of the bail) and also by the toggle spring of the hold-up link. This pivoting of the bail moves its rear edge down in front of the sensing finger "steps". Note: In this neutral position the bail will prevent the sensing fingers from being activated when quotient digits are counted into the multiplier/quotient gears during division operations.



The hold-up engaging arm on the left end of the multiplier sensing bail shaft is restored to neutral with the sensing bail... releasing the hold-up link. The hold-up link is pushed forward by its toggle spring. As the hold-up link moves forward, its blocking arm moves off the rearward lug of the hold-up latch extension and the trip arm of the hold-up link contacts the forward offset lug of the hold-up latch extension... pivoting the hold-up latch out of engagement with the main cam shaft clutch pawl. The pawl engages its drive gear and the second machine cycle resumes....With the hold-up latch thus released, a "step" on the lower edge of the trip arm rests against the rear frame of the decimal unit and the trip arm remains aligned with the forward offset lug of the hold-up latch extension....

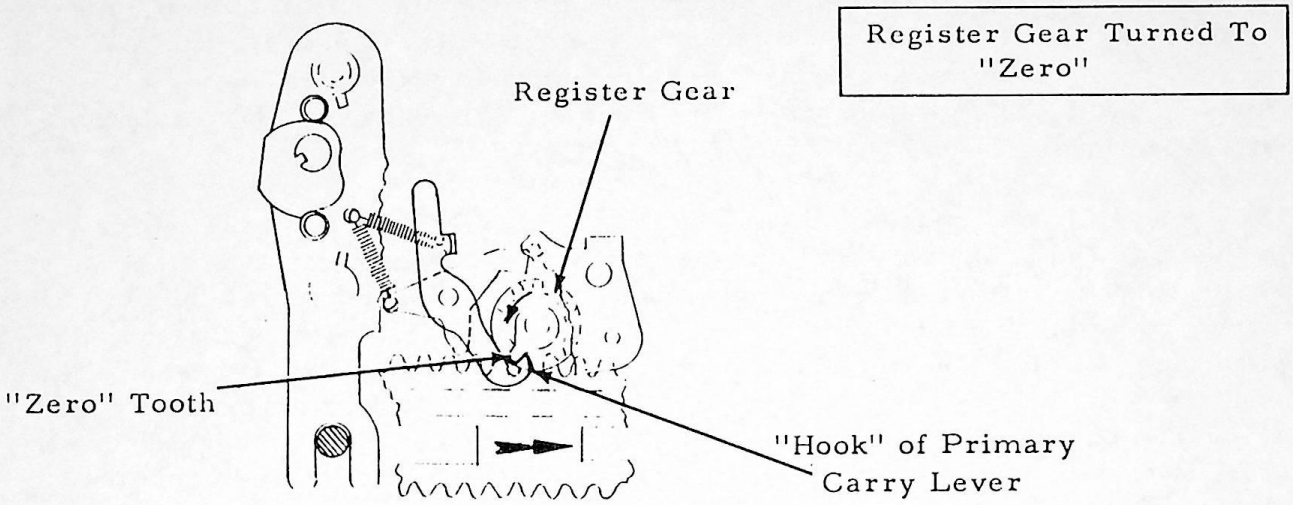
As the main shaft cycles, the hold-up latch...which is riding on the clutch restoring cam...is pivoted by the high section of the cam to a point where the rear offset lug of the hold-up latch extension contacts the lower edge of the trip arm. This raises the trip arm so that its "step" can enter the slot in the rear frame of the decimal unit...which holds the trip arm out of alignment with the forward lug of the hold-up latch extension. In this position the trip arm of the hold-up link does not interfere with the functioning of the hold-up latch on other operations.



Operating slide #2 is driven forward by the cam follower of the total/sub-total cam (riding on the total lobe). The register total latch on operating slide #2 pivots the register engaging segment. The segment operates the register positioning cam shaft, moving the register down. The register gear detents are cammed out of engagement with the register gears as the gears engage the racks.

This is similar to the register engaging movement described under "Enter Dividend Key".... The difference being: On this "product" cycle, the register engaging segment is operated by the #2 operating slide which will engage the register before the racks move rearward (for totaling) and disengage the register at the half-way point in the cycle...when the racks have moved to the rear. In "Enter Dividend" the segment is operated by the #1 operating slide...which engages the register after the racks have moved rearward (for entering), then disengages the register when the racks have been driven forward.

The rack restoring bar moves to the rear, permitting the racks which are engaged with those register gears that have been displaced from zero position to be pulled rearward by their springs. The racks "total" the register



by turning the gears in a counter-clockwise direction to zero position. When a gear reaches zero position, its single "zero" tooth contacts the hook of the primary carry lever. The angle of this hook tip is such that it will prevent the register gear from turning in a counter-clockwise direction (total) when the zero tooth contacts it. Note: When the register gear is turning in a clockwise direction, the zero tooth will cam the hook tip down ... rocking the primary carry lever.

As the racks move rearward they cam down the decimal activator bail ... engaging the decimal cam follower link with the right arm of the decimal actuator arm shaft. The decimal cam rocks its cam follower ... pulling the link forward which pivots the decimal actuator arm shaft... operating the upper (total) decimal selecting bar.

As the rack restoring bar reaches its rearmost position, the aligner pawls start to engage the racks and the hammers are "fired" ... printing the product amount with the total (*) symbol.

With the racks held by the aligner and the product printed the #2 operating slide moves to the rear permitting the register to be pulled up out of engagement with the racks by the action of the restoring spring on its engaging segment.

On the second half of this second cycle all the activated mechanism is restored to normal position and the platen is double spaced. As the program feed plate is restored to the right, the lower multiplier feed pawl engages the outer feed ratchet gear ... indexing the multiplication program cam shaft to its normal position. This releases program slides #9 (register total) and #13 (shift & cycle clutch trip).

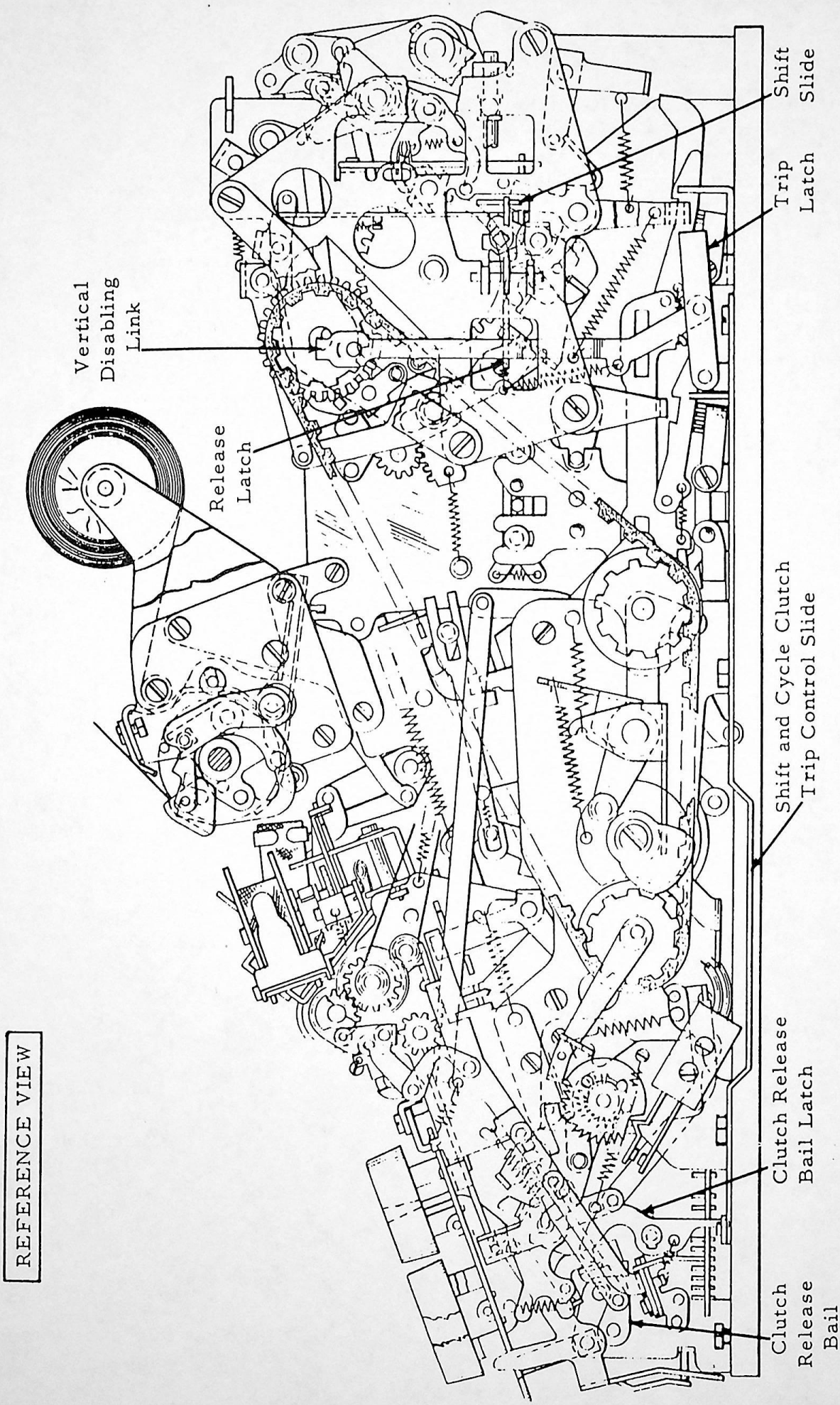
Release Latch For Shift and Cycle Clutch Trip Control Slide

If, during the multiplication, the selector had shifted more than five columns to the left, it would not have had sufficient time to be return shifted to its "home" position as the cycle ended .... In this event the release latch for the shift and cycle clutch trip control slide would remain engaged. (See reference view on following page).

This release latch engages the vertical disabling link attached to the trip latch on the rear end of the shift and cycle clutch trip control slide. It is disengaged by the right end of the shift slide and engaged by its spring anytime the shift slide moves to the left. (During multiplication the shift slide was moved to the left when the multiplier sensing bail was restored). When engaged, it prevents the shift & cycle clutch trip control slide from being moved forward to its normal position. This slide and its bell crank thus remain activated although their program slide has been restored. In activated position the bell crank holds the clutch release bail latch over the clutch release bail.

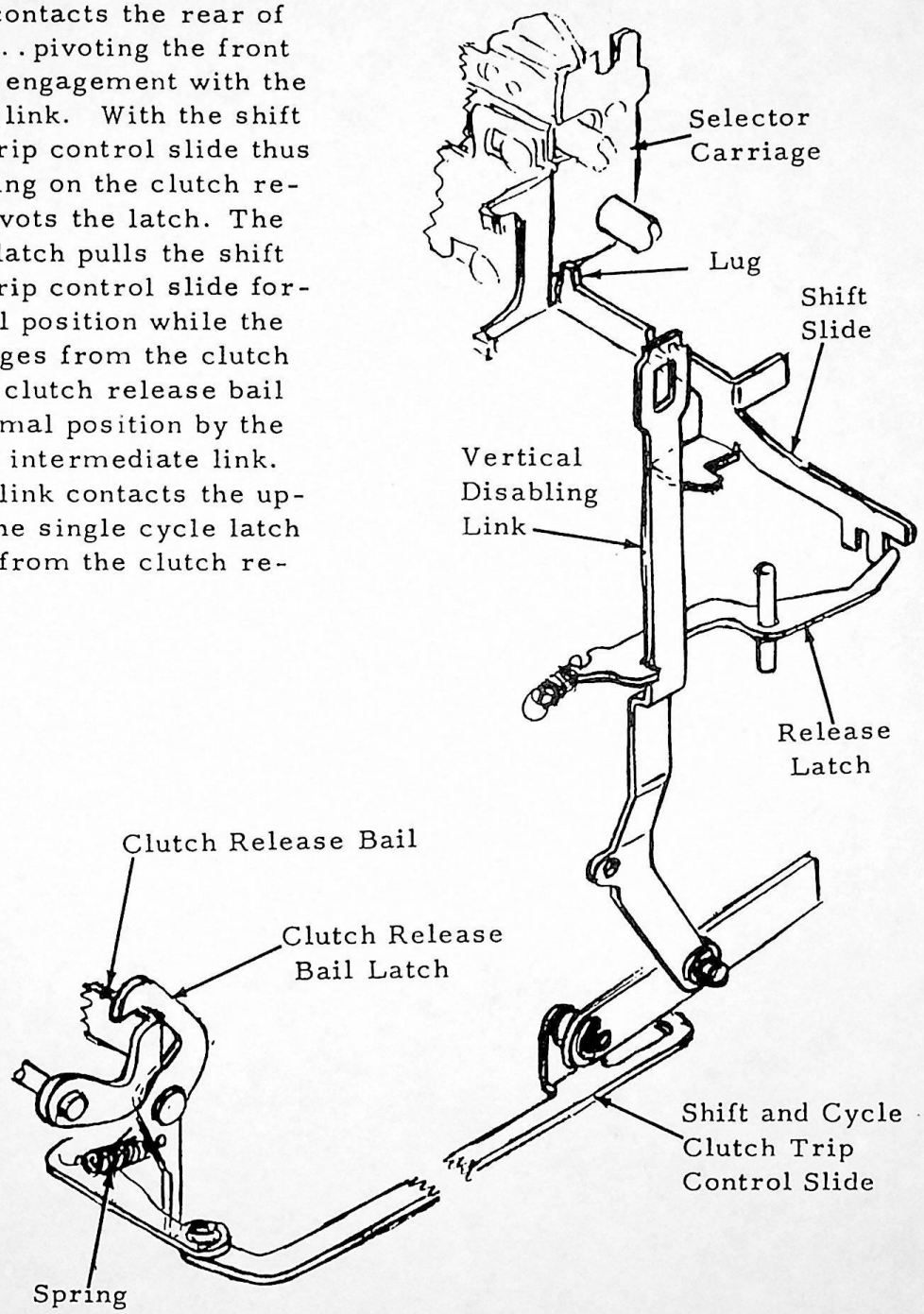
Therefore, if the selector is still being shifted to the right at the completion of the second multiplication cycle, the clutch release bail remains activated. The clutch release link however, will be engaged by the single cycle latch at the end of the cycle...preventing another cycle.

This situation is unique in that the function key has been restored and the single cycle latch is still engaged with the clutch release link. Under these circumstances a function key could be depressed ... but would not initiate a cycle.



REFERENCE VIEW

When the selector is shifted from the second column to the first column ("home" position) the right end of the selector carriage contacts a lug on the top of the shift slide...driving the shift slide to the right. The right end of the shift slide contacts the rear of the release latch...pivoting the front of the latch out of engagement with the vertical disabling link. With the shift and cycle clutch trip control slide thus released, the spring on the clutch release bail latch pivots the latch. The lower end of this latch pulls the shift and cycle clutch trip control slide forward to its normal position while the upper end disengages from the clutch release bail. The clutch release bail is restored to normal position by the two springs on its intermediate link. The intermediate link contacts the upper offset lug of the single cycle latch ...disengaging it from the clutch release link.



High Speed Calculating Mechanism. . . Multiplication

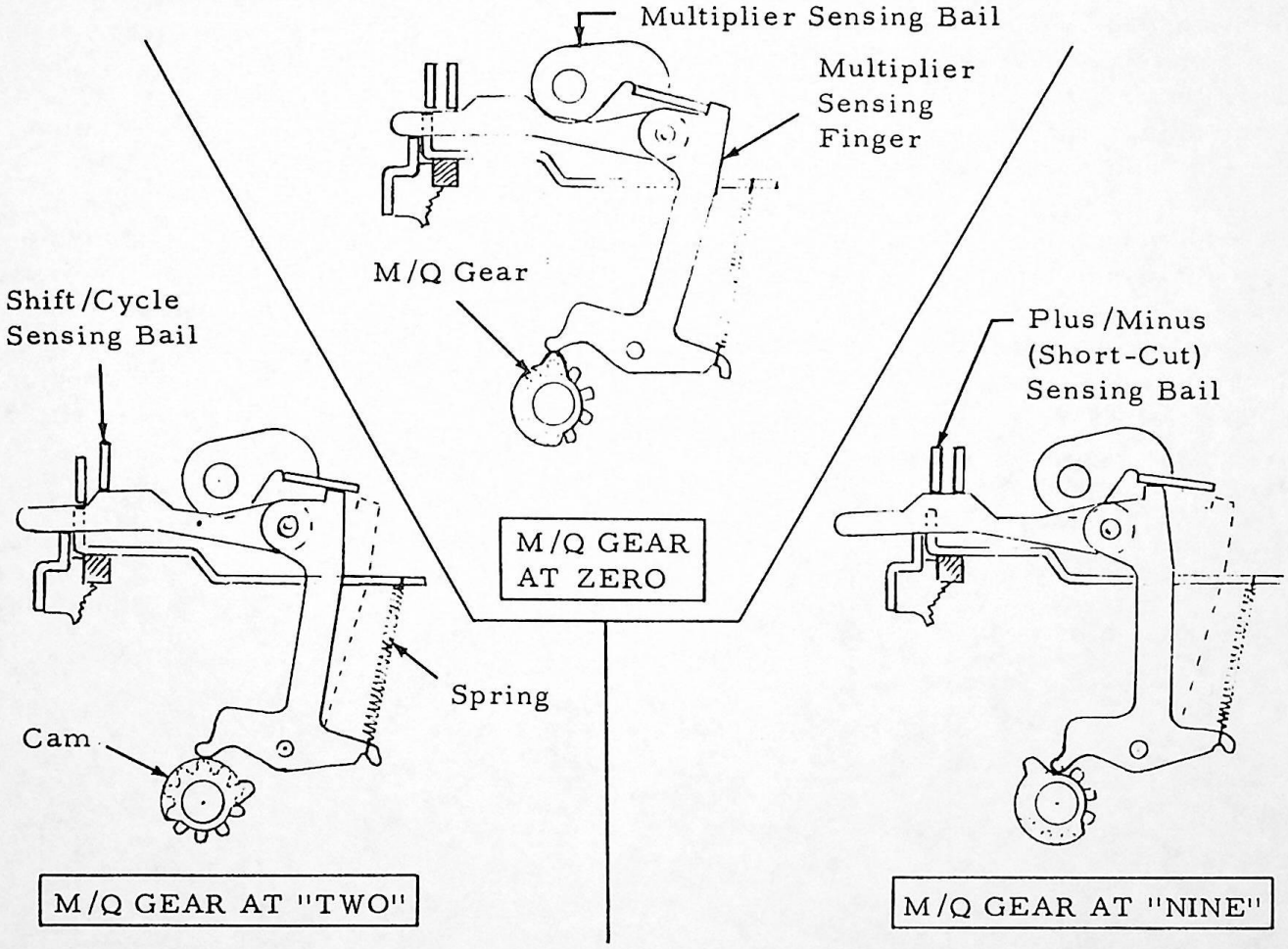
Example No. I. . . . Basic Multiplication

Example: 3 x 2= 6

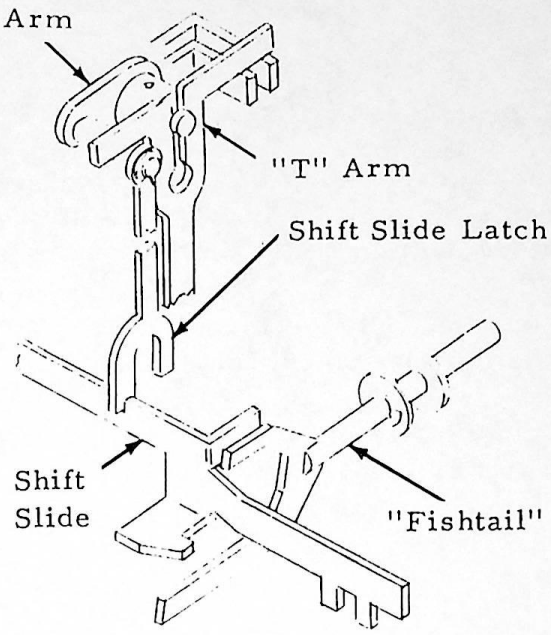
The multiplicand (3) was entered in the first setable gear at the right end of the selector by the × key. . . . The multiplier (2) was entered in the first column of the multiplier/quotient gears on the first machine cycle of this operation.

When the multiplier was entered, the gear was displaced two teeth away from zero position in a clockwise direction.

When the 'T' arm raised the sensing bails the sensing finger for this first column gear was pivoted by its spring in a counter clockwise direction until it contacted the cam on the multiplier/quotient gear.



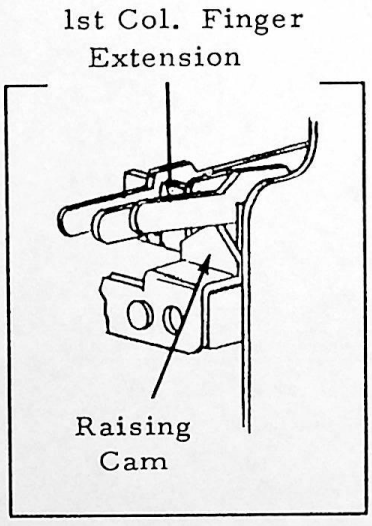
NOTE: With any multiplier digit from one thru five entered, the sensing finger will ride on the middle position section of the cam. . . . With any digit from six thru nine entered, the sensing finger will ride on the low section of the cam. . . . With the gear at zero position, the sensing finger is held in its full clockwise position by the high point of the cam and therefore cannot be pivoted when the sensing bails are raised.

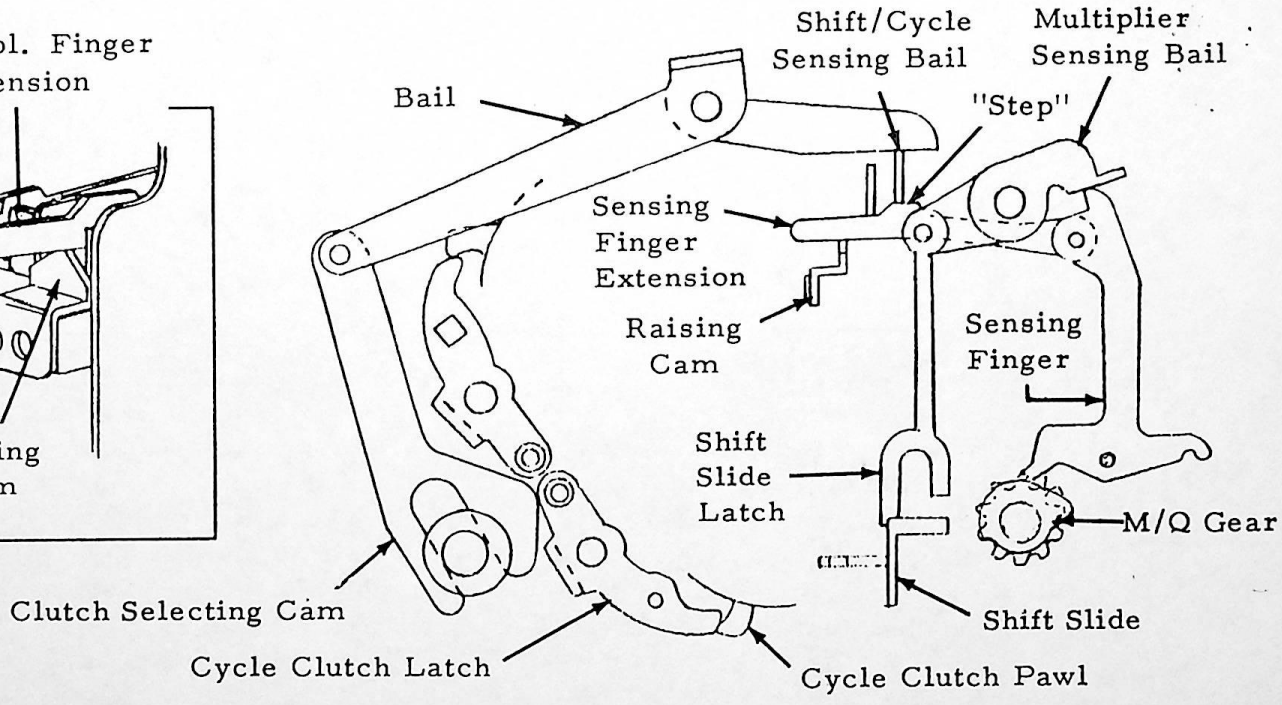


Also when the 'T' arm raised the sensing bails the arm on the right end of the multiplier sensing bail shaft pivoted downward. The stud on this arm carries the shift slide latch. This latch moved down into a notch on top of the shift slide where it will prevent the shift slide from moving to the left until the multiplier sensing bail shaft is neutralized.

When the 'T' arm released the sensing bails, the multiplier sensing bail started to pivot in a clockwise direction (toward its neutralized position)but was immediately stopped by the top of the first column sensing finger. This keeps the hold-up engaging arm on the left end of the multiplier sensing bail shaft to the rear so that the blocking arm of the hold-up link prevents release of the hold-up latch. It also keeps the shift slide latched to the right.

With the selector in "home" position, the raising cam on the top right end of the selector carriage frame is located under the upper extension of the first column sensing finger... holding the extension up in the "active" position. Therefore, when the 'T' arm released the sensing bails, the shift/cycle sensing bail started to pivot (counterclockwise) toward its normal position but was immediately stopped by the "step" on top of the raised sensing finger extension. With the shift/cycle sensing bail held in this raised position, it keeps the bail for the clutch selecting cam pivoted, counterclockwise, so that the selecting cam is held down in alignment with the roller of the cycle clutch latch.

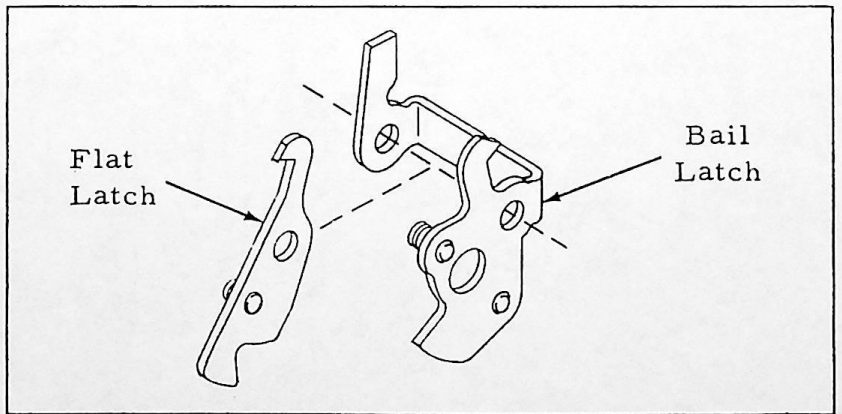




When the clutch starting bail was subsequently pivoted by the program feed movement at the start of the second machine cycle, it pivoted the clutch release lever which drove the clutch selecting cam in against the roller of the cycle clutch latch. This pivoted the latch out of engagement with the cycle clutch pawl.... The pawl is pushed by its spring into engagement with its rotating drive gear and the cycle clutch starts to rotate.

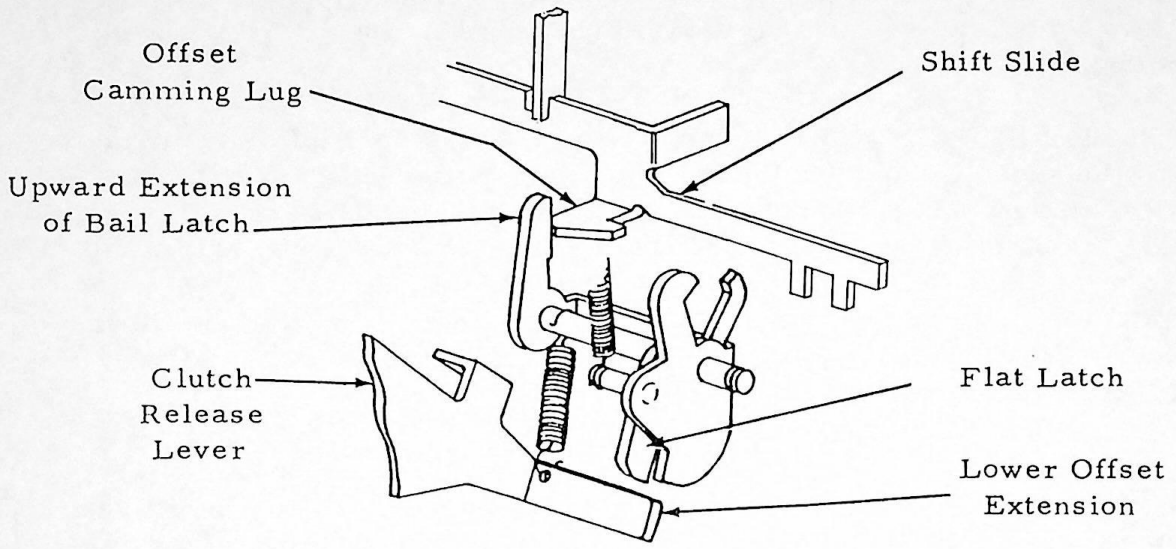
> NOTE: If a figure had not been entered in the first multiplier/quotient gear, the sensing finger extension would be positioned to the rear so that its "step" was not under the shift/cycle sensing bail.... In this event, the shift/cycle sensing bail would have pivoted counter-clockwise to its normal position when the 'T' arm was released. The bail for the clutch selecting cam would have then been pivoted by its spring... raising the cam into alignment with the roller of the shift clutch latch. (See drawing on page V-D-29).

When the clutch release lever pivoted, its lower offset extension moved down... out from between the two "blades" of the "scissors". (Note: The scissors will keep the clutch release lever latched in activated position until the selector returns to its "home" position at the end of the multiplication). The "scissors" consist of two latches... a bail shaped latch and a flat latch. They both pivot on a short shaft. The left end of the bail shaped latch (which we will call the "bail latch") has an upward extension and its right end extends both upward and downward. The upper portion of the right end has a pointed camming surface (pointing rearward).... The lower portion forms the rear "blade" of the scissors and its bottom edge is the latching surface. This right end of the bail latch also has two spring studs. The spring on the upper stud exerts tension in a clockwise direction on the latch. The spring on the lower stud is connected to a stud on the other scissors latch and it pulls the two "blades" of the scissors together. This other scissors latch (which we will call the "flat latch") also extends both upward and downward. Its upper portion also has a pointed camming surface (pointing forward). This point positions opposite the point of the bail latch. The lower portion of this flat latch forms the front "blade" of the scissors and its bottom edge is the latching surface. The latching surface of the flat latch extends downward slightly more than the latching surface of the bail latch.



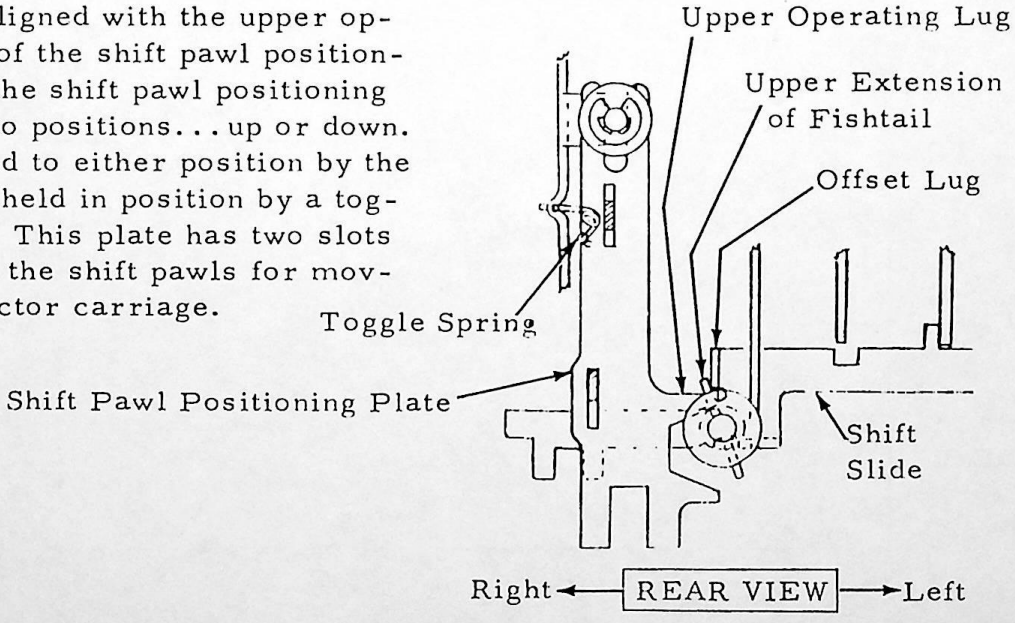
"SCISSORS" LATCHES

As the lower offset of the clutch release lever moves out from between the two "blades" of the scissors, the flat latch is pivoted by the connecting spring in a counter clockwise direction until it limits on the spring stud of the bail latch.... This closes the gap between the "blades" of the scissors and positions the flat latch over the offset extension of the clutch release lever,



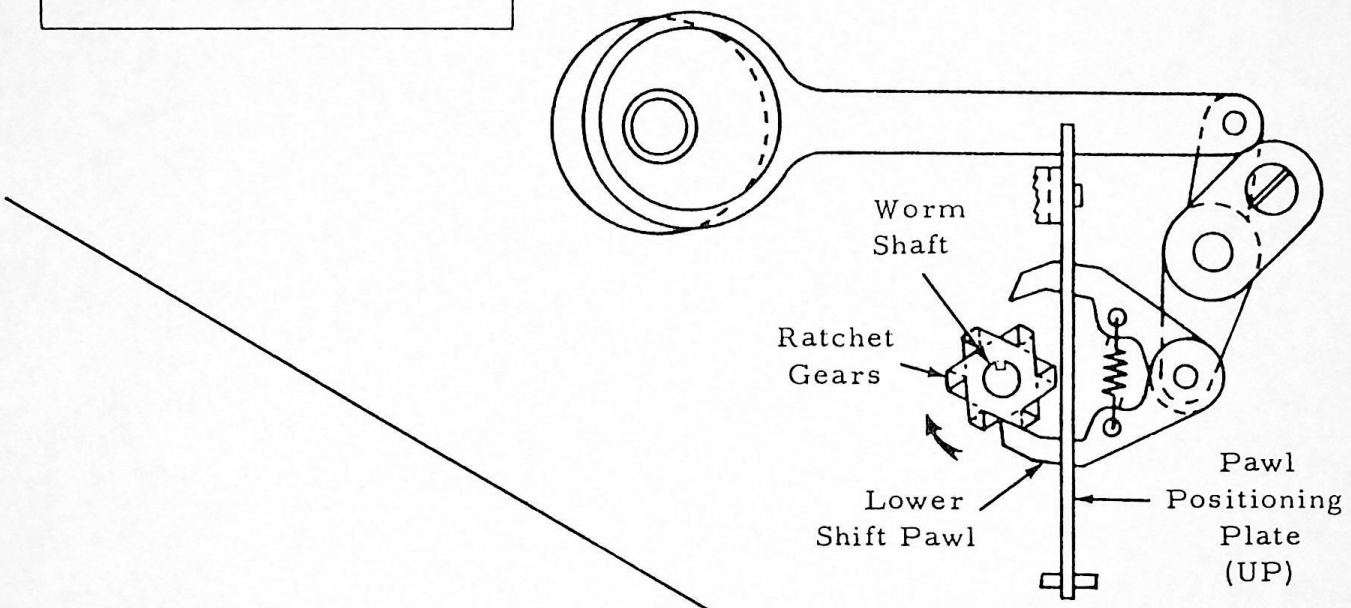
As noted previously, the other spring on the bail latch exerts tension in a clockwise direction. The latch is prevented from turning however, by the offset camming lug of the shift slide. This lug extends forward from the bottom edge of the shift slide near its right end. With the shift slide held to the right, its camming lug (in contact with the upward extension of the left end of the bail latch) keeps the scissors pivoted in a counter clockwise direction.

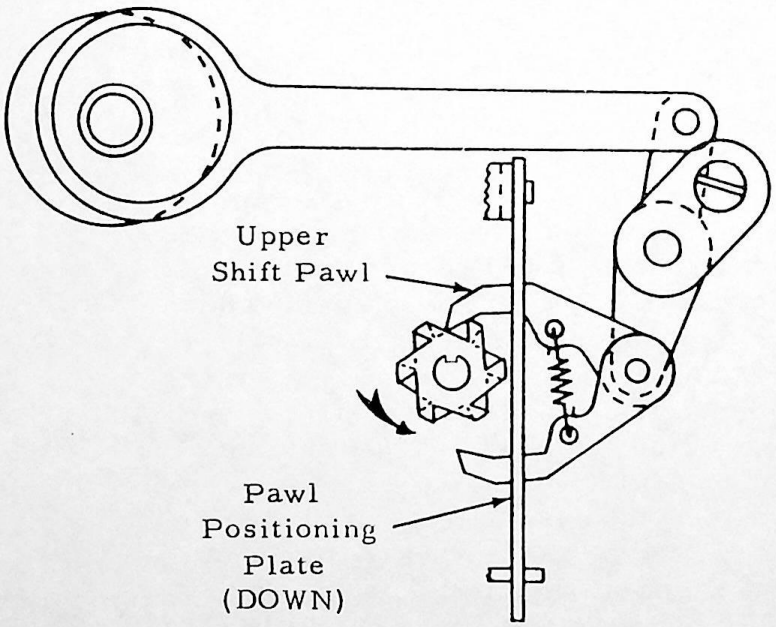
There is another offset lug near the right end of the shift slide which extends rearward.... This lug contacts the upper extension of the shift direction control fork (we will refer to this shift direction control fork as the "fishtail"). With the shift slide held to the right, the lug holds the upper extension of the fishtail to the right so that the camming edge of this upper extension is aligned with the upper operating lug of the shift pawl positioning plate. The shift pawl positioning plate has two positions... up or down. It is cammed to either position by the fishtail and held in position by a toggle spring. This plate has two slots which guide the shift pawls for moving the selector carriage.



There are two ratchet gears keyed to the right end of the selector carriage worm shaft. Although both gears are alike, they are assembled to the worm shaft so that they work in opposite directions. The lower shift pawl is aligned with the outer ratchet gear by the pawl positioning plate when the plate is moved to its up position .... This will cause a clockwise turning of the worm shaft resulting in the selector carriage being shifted to the left on a shift cycle. The upper shift pawl is aligned with the inner ratchet gear by the pawl positioning plate when the plate is in its down position. This will cause a counter clockwise turning of the worm shaft, resulting in the selector carriage being shifted to the right on a shift cycle.

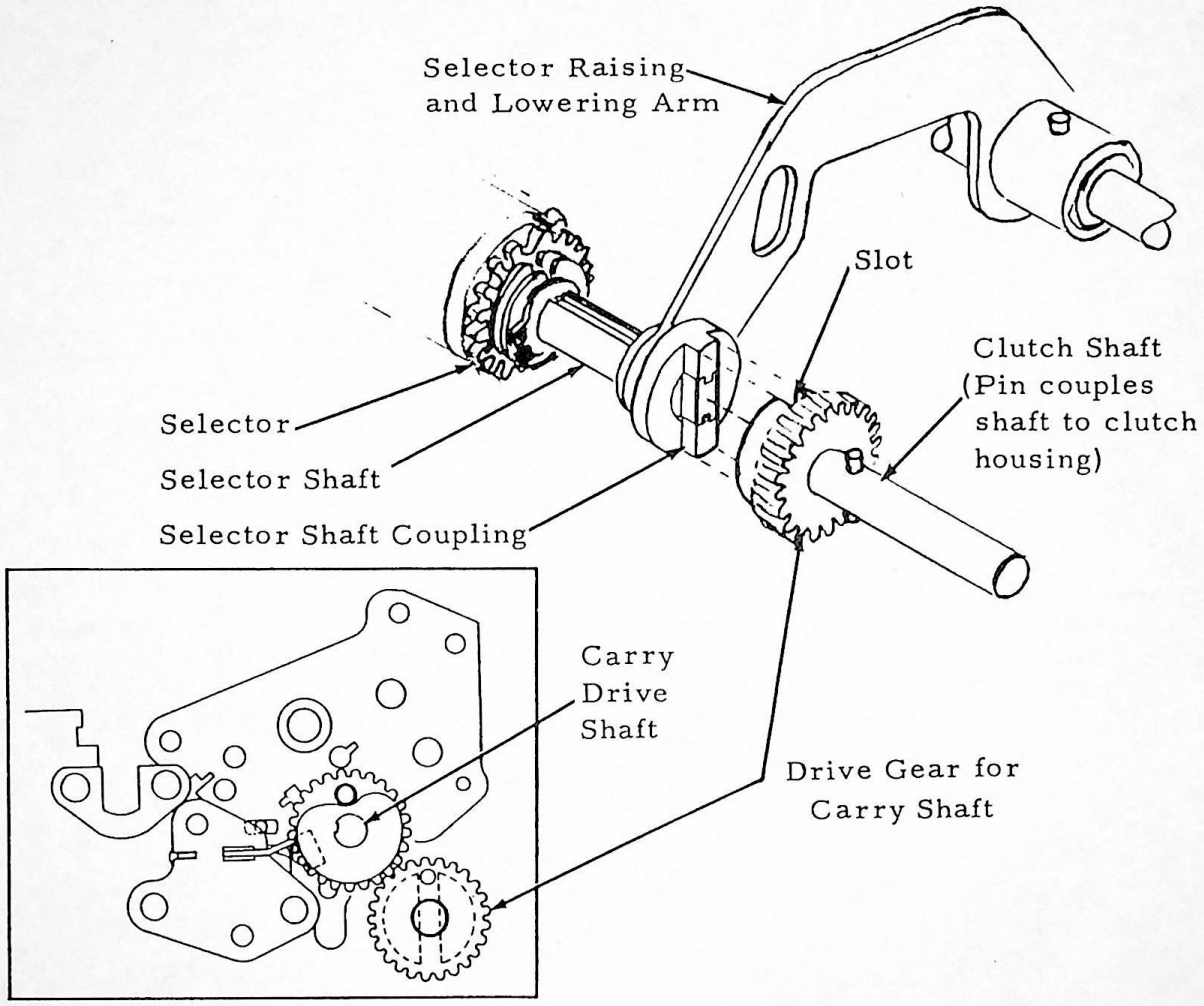
LEFT SHIFT POSITION





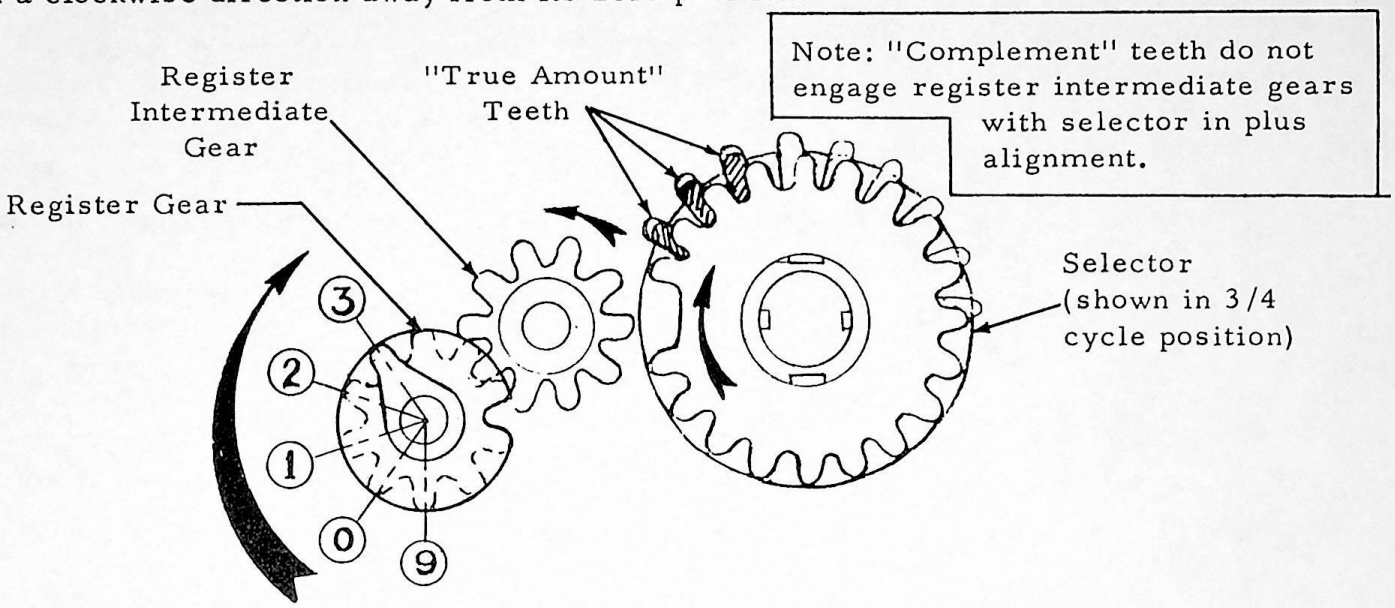
RIGHT SHIFT POSITION

Getting back to the cycle clutch - the rotating drive gear in the clutch is engaged by the clutch pawl.... The clutch pawl, secured in the clutch housing, turns the clutch housing (clockwise). The inner hub of the clutch housing is slotted and the slot fits over a pin in the clutch shaft... so the clutch shaft is turned. The inner end of the clutch shaft contains the drive gear for the carry mechanism and the face of this drive gear has a slot into which the projections of the selector shaft coupling fit. Both the coupling and the selector are keyed to the selector shaft... so the engagement of the cycle clutch causes the selector to rotate.

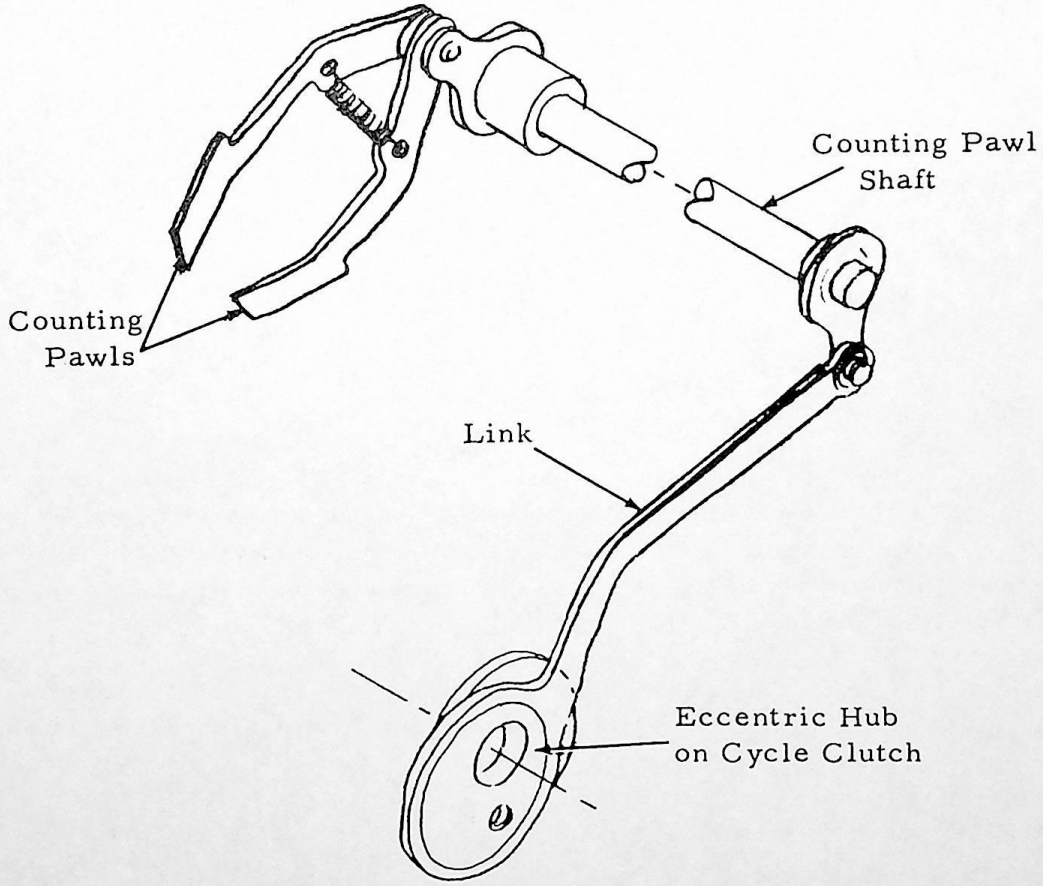


NOTE: This slot-coupling arrangement will permit the raising and lowering of the selector shaft only when the cycle clutch is in neutral position.... When the clutch is in neutral, the slot is tangent to the arc prescribed by the selector raising and lowering shaft arms.... When the clutch is turned away from neutral, the slot is no longer tangent to the arc and the selector cannot be moved up or down. The neutral position of the clutch therefore, thru the coupling, provides the basic alignment of the selector with its clearout gears and the racks when setting-up.... The lugs on the "C" shaped offset of the selector positioning plate (as was stated previously) refine this engaging alignment and remove the torque stresses of selector set-up from the cycle clutch.

As the selector turns, the three teeth of its first column gear that are in the "true amount" zone displace the first column register intermediate gear three teeth. The register intermediate gear displaces the register gear three teeth in a clockwise direction away from its zero position.

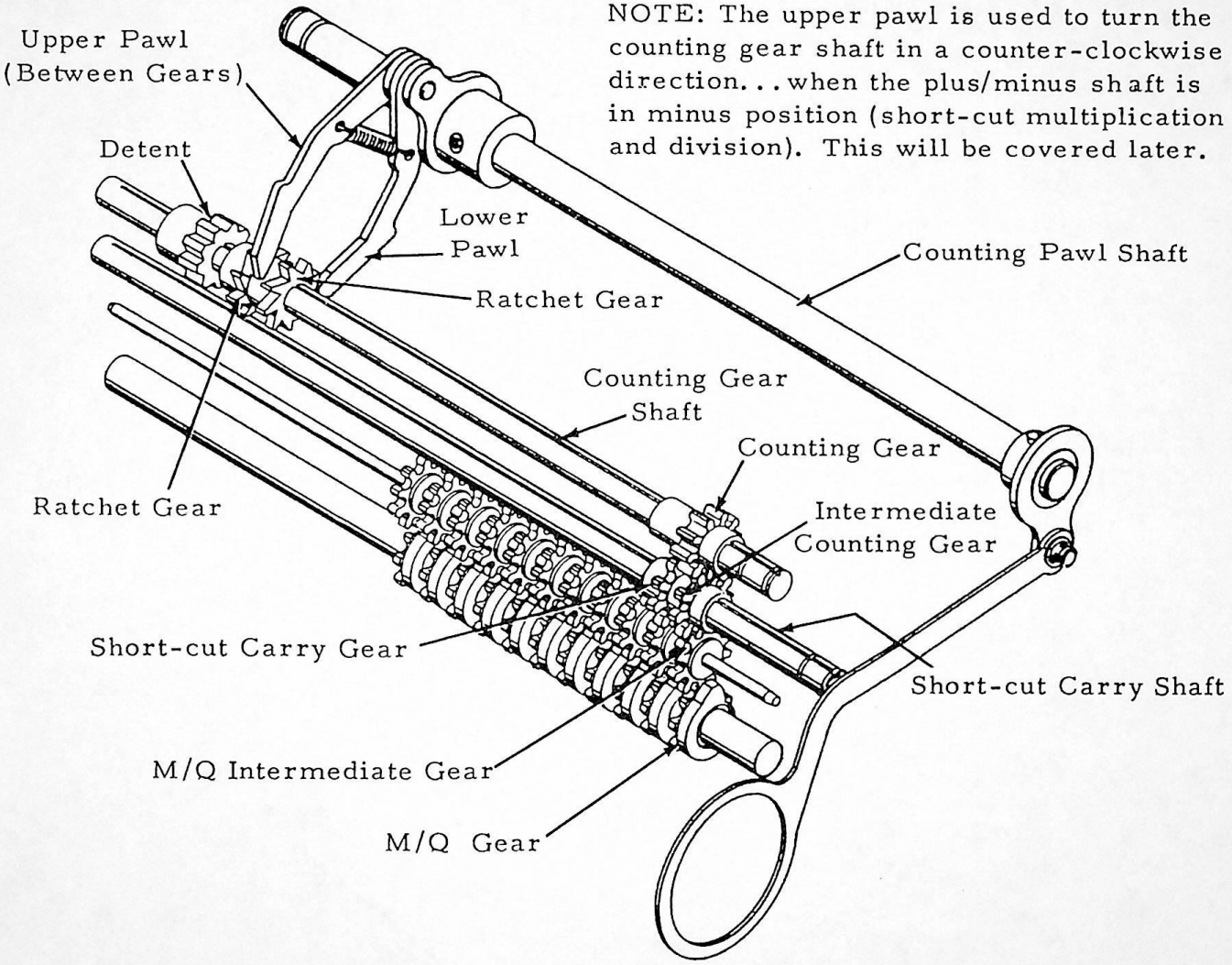


An eccentric hub on the cycle clutch operates a link attached to an arm on the right end of the counting pawl shaft. As the clutch rotates the link is driven first to the rear... then forward again... rocking the counting pawl shaft.



Two counting pawls are attached to an arm near the left end of the counting pawl shaft...they move first forward then rearward as the shaft is rocked. The operating tip of the lower pawl is positioned under the counting gear shaft and....as the pawls are rocked forward, this lower pawl will engage a ratchet gear on the counting gear shaft and detent the shaft one tooth in a clockwise direction. The operating tip of the upper pawl is positioned over the counting gear shaft and... with the plus/minus shaft in its normal (plus) position...as it is now...the upper pawl does not engage its ratchet gear.

NOTE: The upper pawl is used to turn the counting gear shaft in a counter-clockwise direction...when the plus/minus shaft is in minus position (short-cut multiplication and division). This will be covered later.



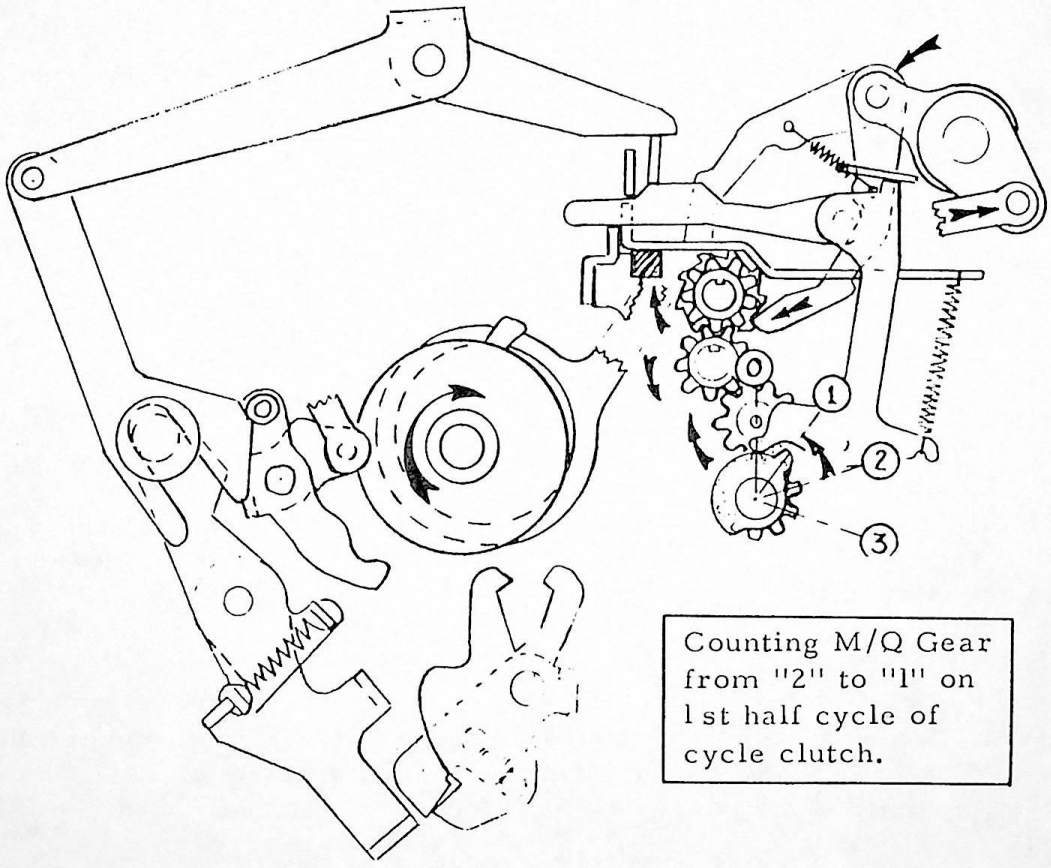
The counting gear shaft contains a single counting gear which is keyed to the shaft. This counting gear is trapped between the right end of the selector carriage frame and a bracket on the selector carriage frame. The gear, therefore slides laterally on its shaft when the selector carriage is shifted.

Positioned under the counting gear...and in mesh with it...is an intermediate counting gear. This intermediate counting gear is mounted on the short-cut carry shaft...however, it is not keyed to the shaft and therefore its rotation and the shaft's rotation are independent. The intermediate counting gear is also trapped by the selector carriage frame and slides laterally on its shaft...in mesh with the counting gear...when the selector carriage is shifted.

At this point in our description the selector carriage is still in its right end (home) position, and therefore the intermediate counting gear is also in mesh with the intermediate gear for the first column multiplier/quotient gear.

So...when the lower counting pawl detented its ratchet gear one tooth clockwise, the counting gear turned the intermediate counting gear one tooth counter-clockwise...the intermediate counting gear turned the first column M/Q intermediate gear one tooth clockwise...and the M/Q intermediate gear turned the first column M/Q gear one tooth counter-clockwise.

The first column M/Q gear had been displaced two teeth away from its zero position in a clockwise direction when the multiplier digit "2" was entered.... Therefore, the action of the lower counting pawl returns the M/Q gear one tooth nearer to zero position in a counter-clockwise direction. We can say that the gear has been counted back from "2" to "1".

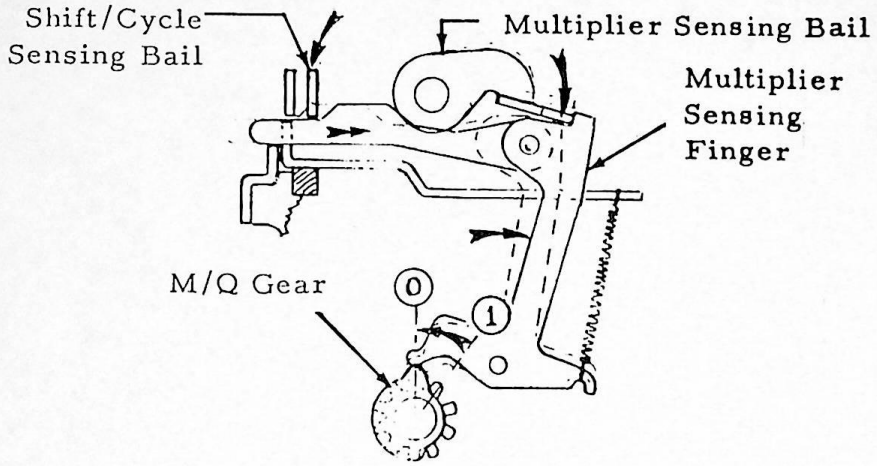


Counting M/Q Gear from "2" to "1" on 1st half cycle of cycle clutch.

In this position the multiplier sensing finger still rides on the middle position section of the cam on the M/Q gear. The sensing finger extension is still held up in active position by the raising cam on the top right end of the selector carriage and the "step" of the sensing finger extension is still holding the shift/cycle sensing bail in the raised position. This keeps the bail for the clutch selecting cam pivoted so that the clutch selecting cam remains down in engagement with the roller of the cycle clutch latch...and, as the cycle clutch completes its first cycle, it continues into a second cycle without interruption....

As the selector cycles a second time the three teeth of its first column gear, that represent the "true amount" of the multiplicand, again displaces the first column register intermediate gear three teeth in a counter-clockwise direction. The register intermediate gear turns the register gear three more teeth in a clockwise direction away from its zero position for a total displacement of six teeth.

On this second cycle of the selector cycle clutch, the lower counting pawl again detents its ratchet gear one tooth and this movement is carried thru to the M/Q gear as previously described. The M/Q gear is then counted back from "1" to "0".



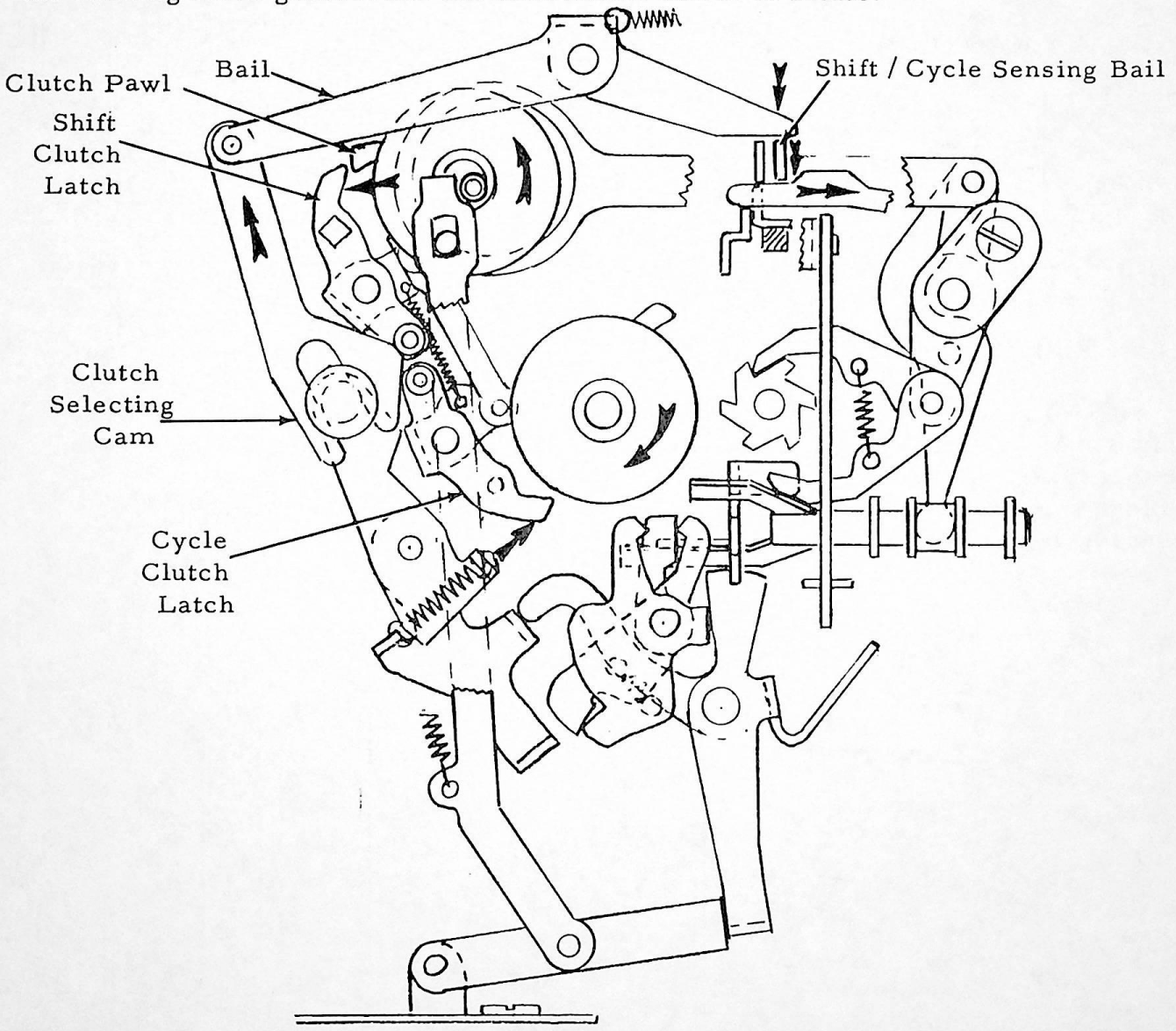
As the M/Q gear moves into zero position the high point of its cam positions under the sensing finger... pivoting the sensing finger in a clockwise direction. This moves the sensing finger extension to the rear. The "step" on top of the sensing finger extension moves out from under the shift/cycle sensing bail and the "step" on top of the sensing finger moves out from under the multiplier sensing bail.

The release of the multiplier sensing bail signals the end of the calculating phase of this operation and the resumption of the machine cycle from this point has been described previously (starting on page V-D-31).... However, the selector must still be shifted to neutralize the high speed clutch starting mechanism and this shifting will occur as the product is being removed from the register.

NOTE: When the multiplier sensing bail pivoted to is neutral position, it raised the shift slide latch up out of the notch in the top of the shift slide. Actually, this shift slide latch does not perform its function of preventing the shift slide from moving to the left during this particular example of the multiplication operation.... This function is performed only when there are multiplier digits in M/Q gears to the left of the first column gear and the selector carriage is shifted left to count-out these digits. The shift slide is held to the left when the selector car-

riage is in "home" (first column) position by the right end of the selector carriage frame contacting an upward projecting lug on top of the shift slide. Therefore, in this example, the shift slide latch is raised before the selector is shifted to the left.

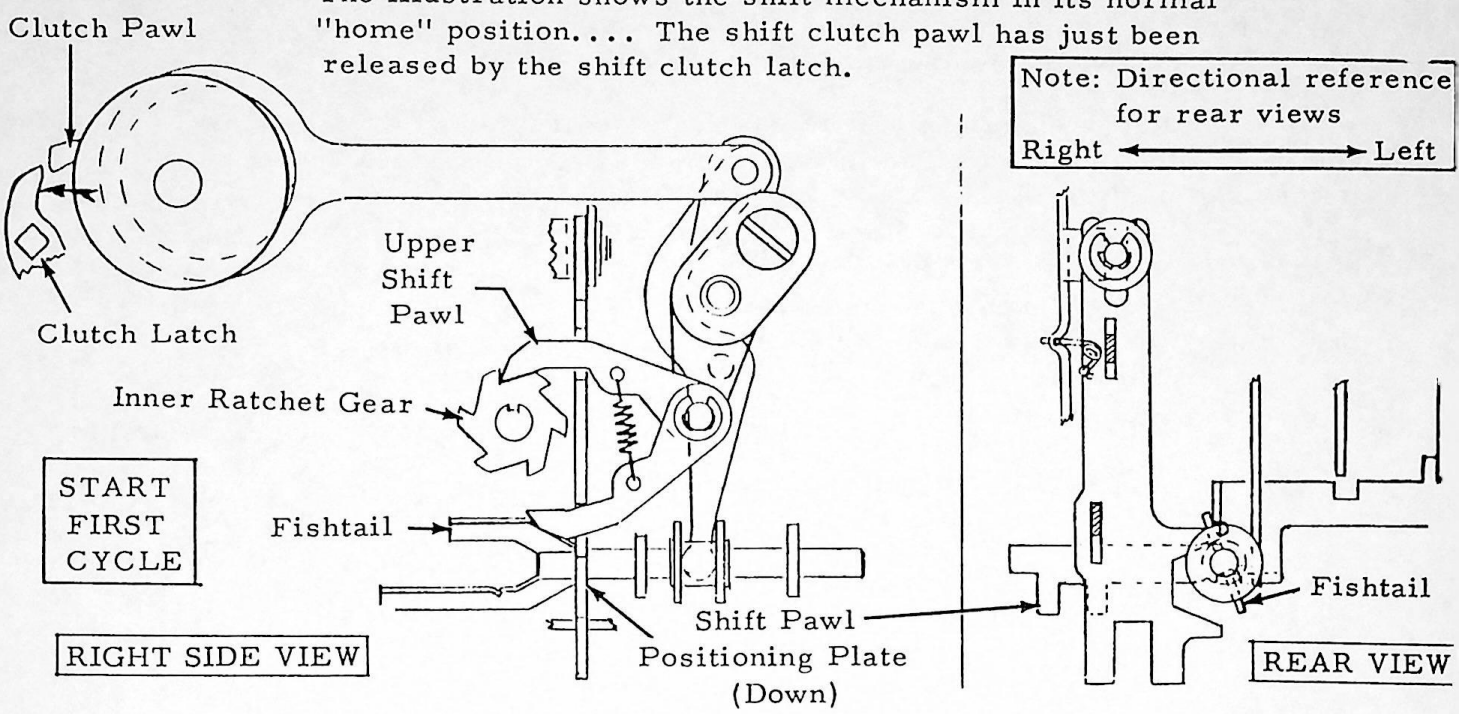
With the shift/cycle sensing bail released, the bail for the clutch selecting cam is pivoted by its spring....pushing the shift/cycle sensing bail down to its neutral position...and raising the clutch selecting cam up out of engagement with the roller of the cycle clutch latch and into engagement with the roller of the shift clutch latch. This pivots the shift clutch latch out of engagement with the clutch pawl...the pawl is pushed by its spring into engagement with the rotating drive gear...and the shift clutch starts to rotate.



At this point the cycle clutch has only completed about half of its cycle...so both clutches are turning at the same time. There is no conflict however, since the actual shifting of the selector carriage occurs on the last half of the shift clutch cycle. By that time the cycle clutch pawl will have contacted the cycle clutch latch which will pivot it out of engagement with its rotating drive gear stopping the rotation of the cycle clutch and selector in neutral position.

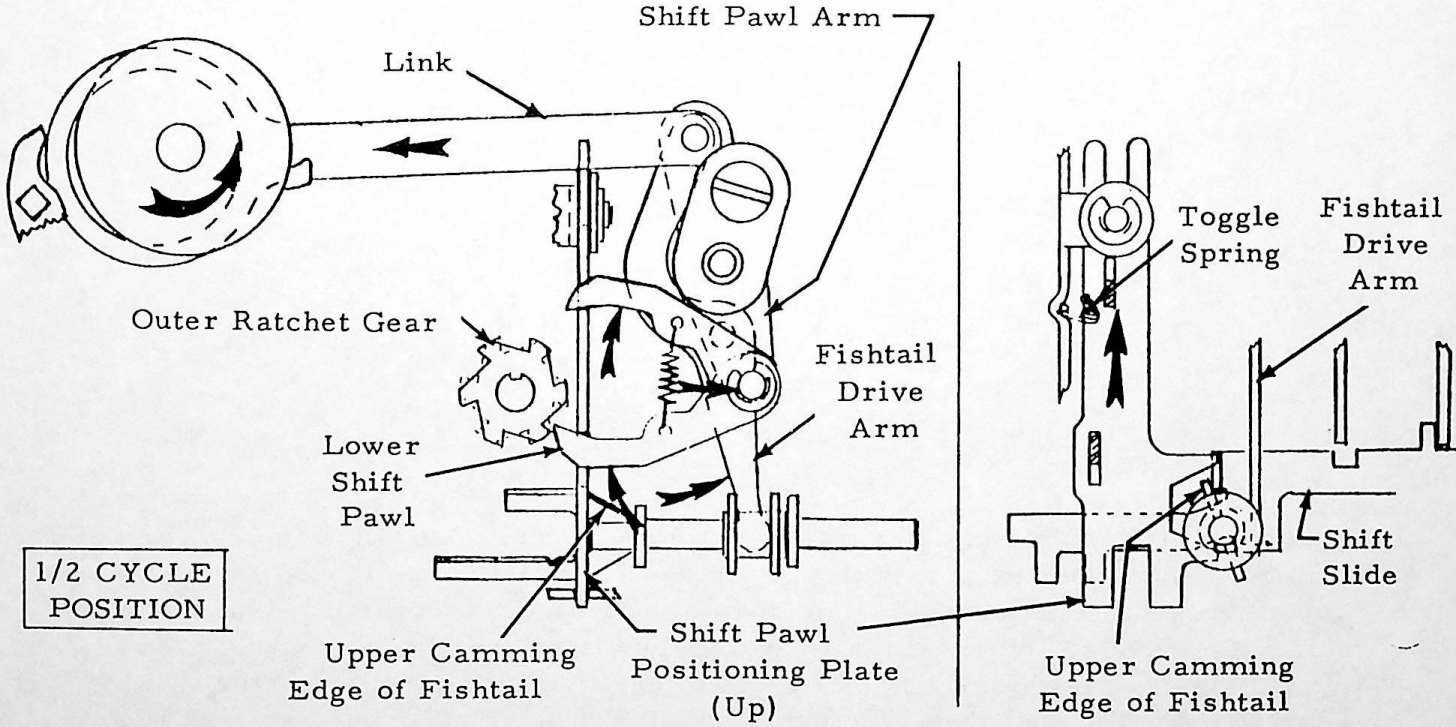
First Shift Cycle....

The illustration shows the shift mechanism in its normal "home" position.... The shift clutch pawl has just been released by the shift clutch latch.

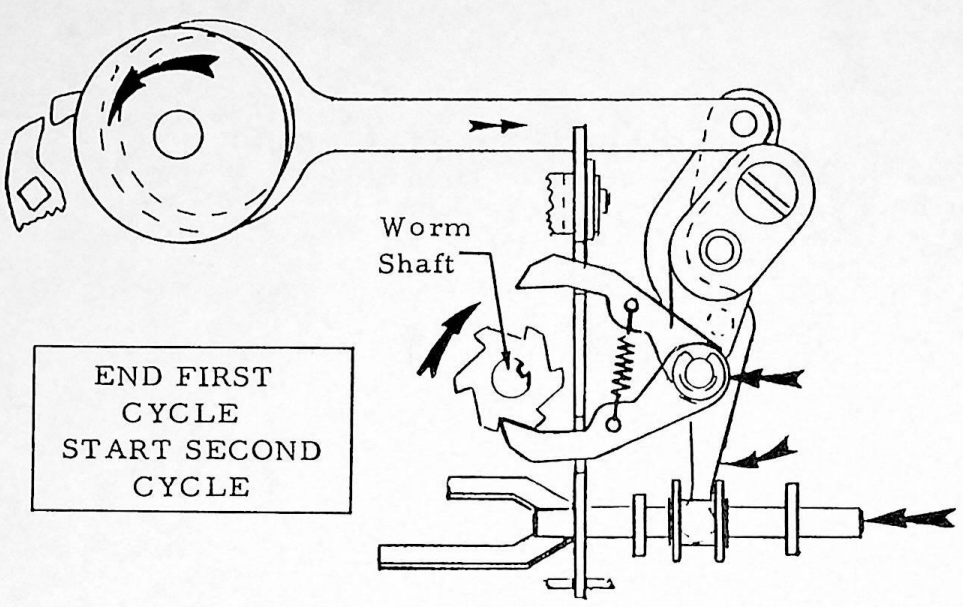


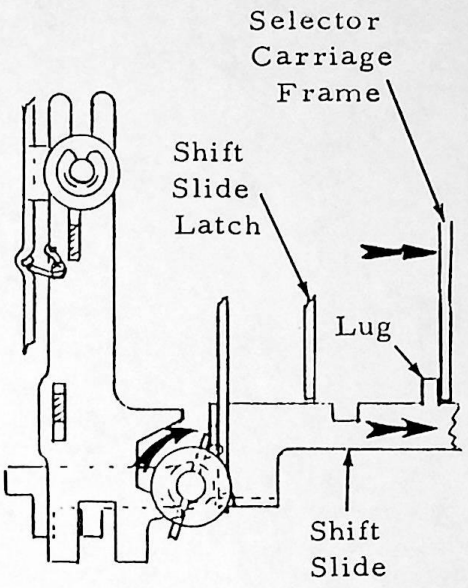
As the shift clutch turns, its eccentric hub pulls its link forward... pivoting the shift pawl arm and fishtail drive arm. The shift pawls are pulled to the rear and the upper pawl moves out of engagement with the inner ratchet gear. The fishtail is also moved to the rear and its upper edge cams the shift pawl positioning plate up so that lower shift pawl aligns with outer ratchet gear for left shift.

Note: The shift pawl positioning plate is held in its up or down position by a toggle spring.

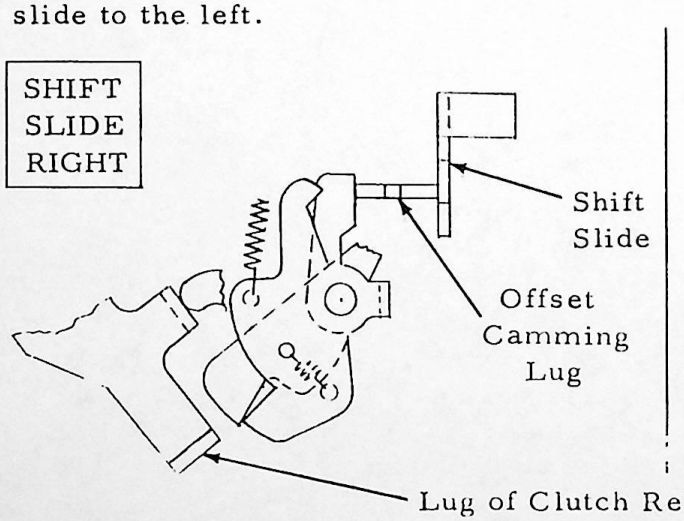


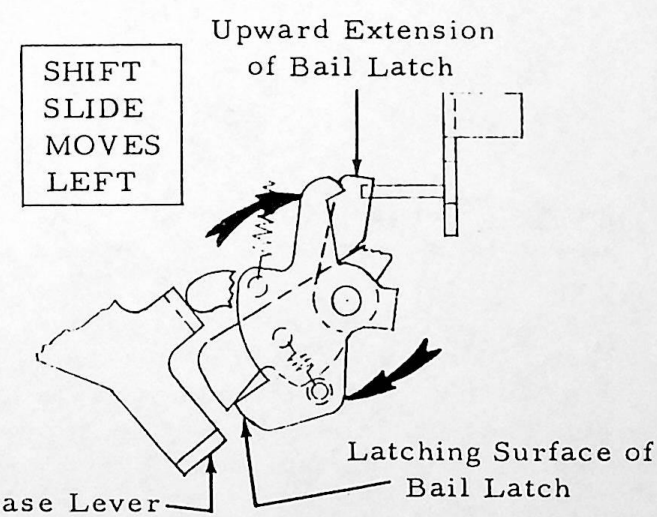
On the second half of the shift clutch cycle, the eccentric hub pushes its link to the rear. The lower shift pawl engages the outer ratchet gear and turns the worm shaft clockwise. . . shifting the selector carriage one column to the left. The fishtail is moved forward at the same time.



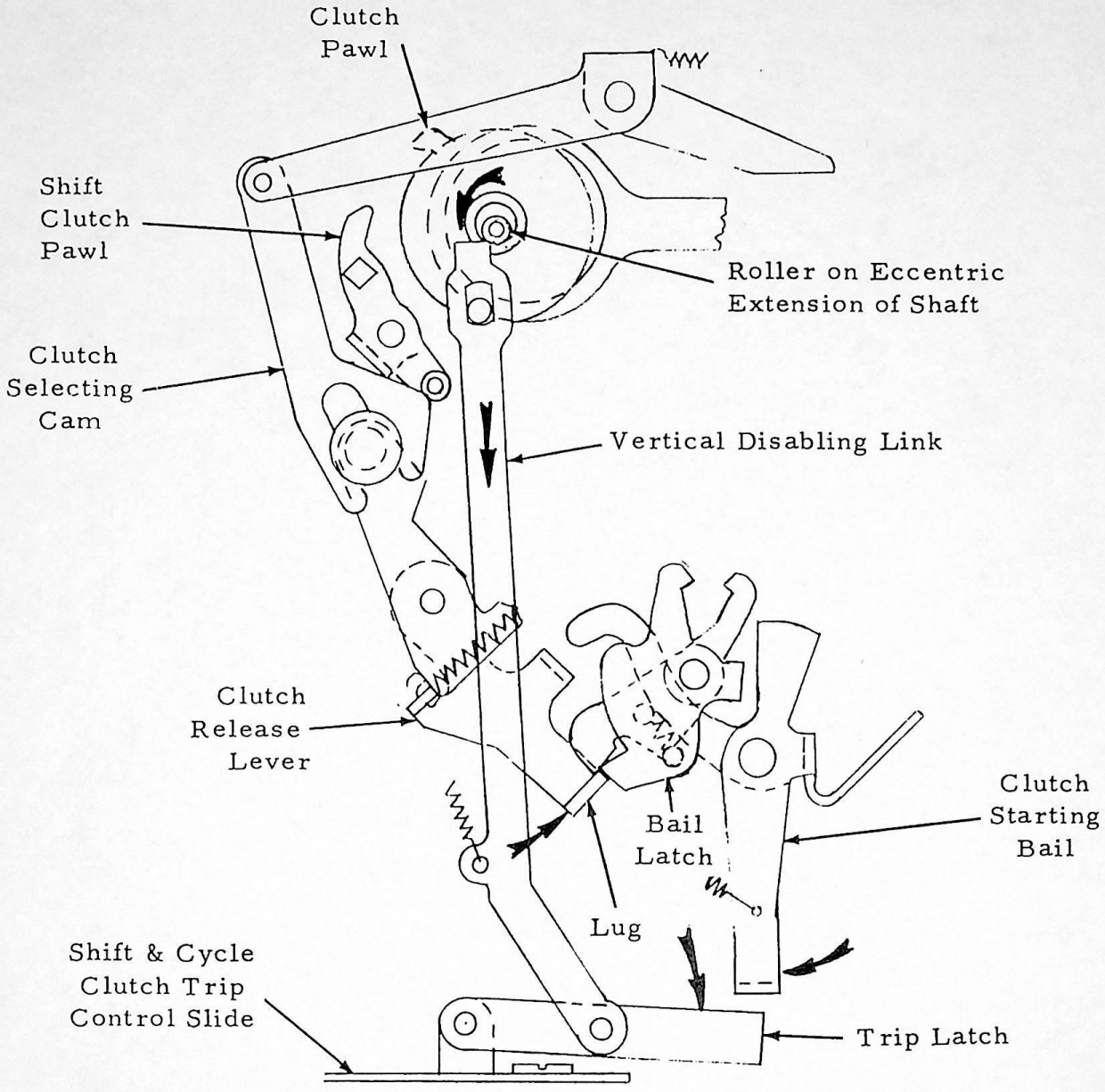


As the selector carriage moves left, its frame moves away from the lug on the shift slide. . .permitting the shift slide to move left (remember. . . the shift slide latch disengaged when multiplier sensing bail was neutralized. . . See page V-D-46) under tension of two springs. . . . The spring on the release latch pulls the latch into engagement with the vertical disabling link and also helps to push the shift slide to the left. . . . As the fishtail moves forward, it is pivoted by its spring so that its lower edge aligns with the lower operating lug on the pawl positioning plate. As this happens, the upper part of the fishtail also helps push the shift slide to the left.





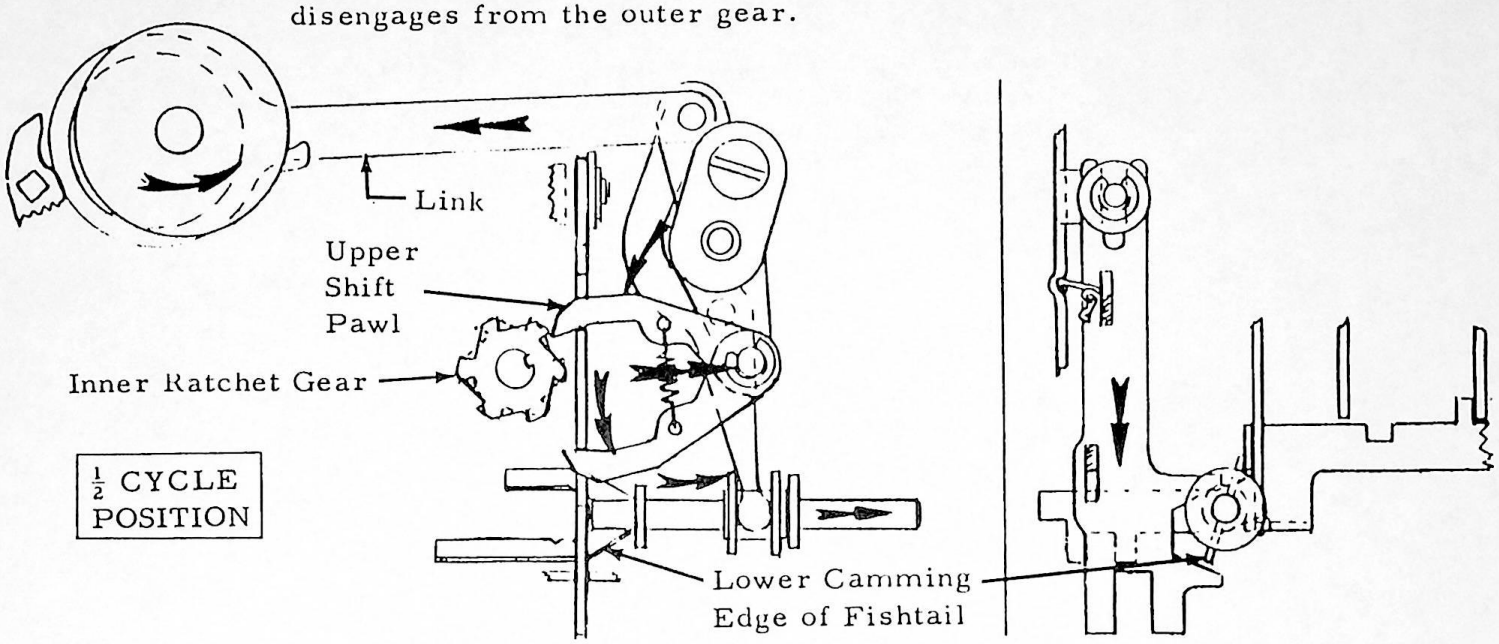
As the shift slide moves left, its offset camming lug moves away from the upward extension of the bail latch of the scissors. . . permitting the scissors latches to be rocked in a clockwise direction by their spring. This positions the latching surface of the bail latch above the lug of the clutch release lever.



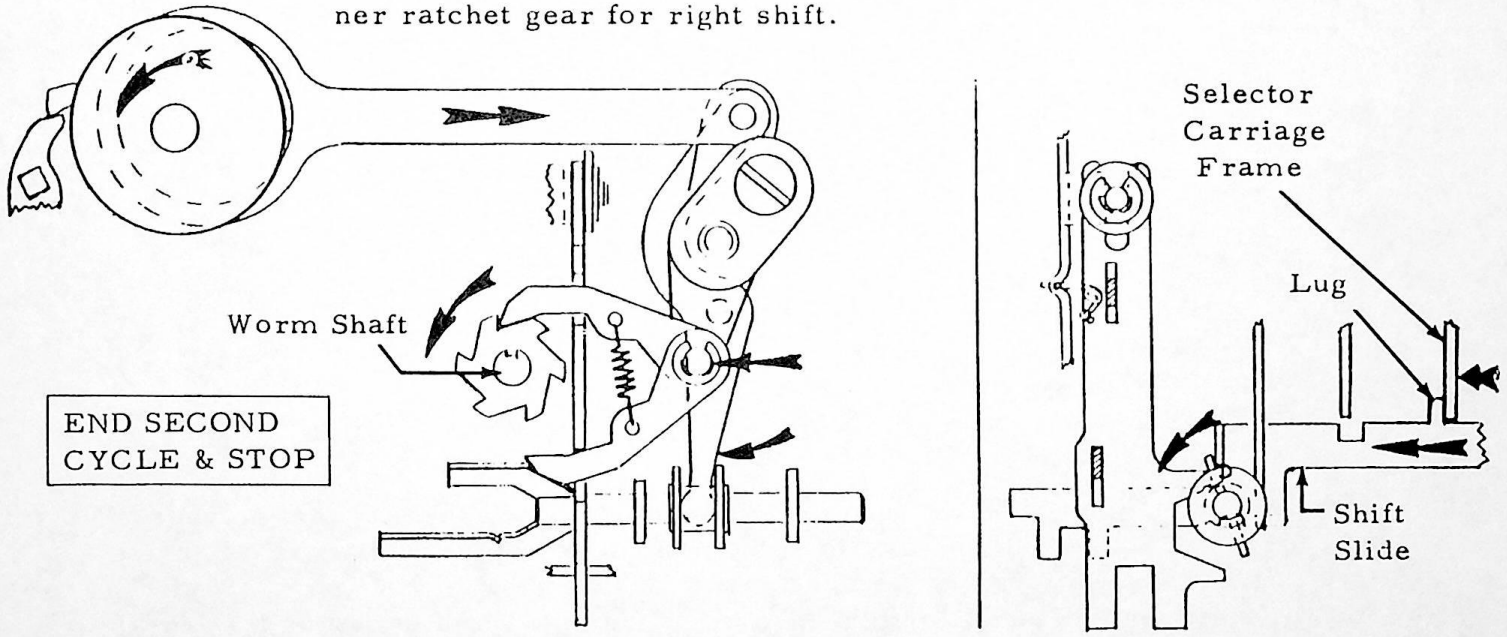
Near the end of this first shift cycle, the roller on the eccentric right end extension of the shift clutch shaft pushes the vertical disabling link down. This moves the trip latch of the shift and cycle clutch trip control slide down... out of engagement with the clutch starting bail. The clutch starting bail is pvioted by its spring... releasing the clutch release lever. The clutch release lever starts to pivot to neutral, but is stopped as its lug contacts the bail latch of the scissors.... This keeps the clutch selecting cam pivoted, which keeps the shift clutch latch pivoted out of the path of the clutch pawl and the shift clutch continues into a second cycle.

Return Shift Cycle ----

Again the shift clutch eccentric hub pulls its link forward...pivoting the shift pawl arm and fishtail drive arm. The shift pawls move to the rear and the lower pawl disengages from the outer gear.



The lower edge of the fishtail contacts the lower operating lug of the pawl positioning plate...camming the plate down so that the upper pawl is aligned with the inner ratchet gear for right shift.

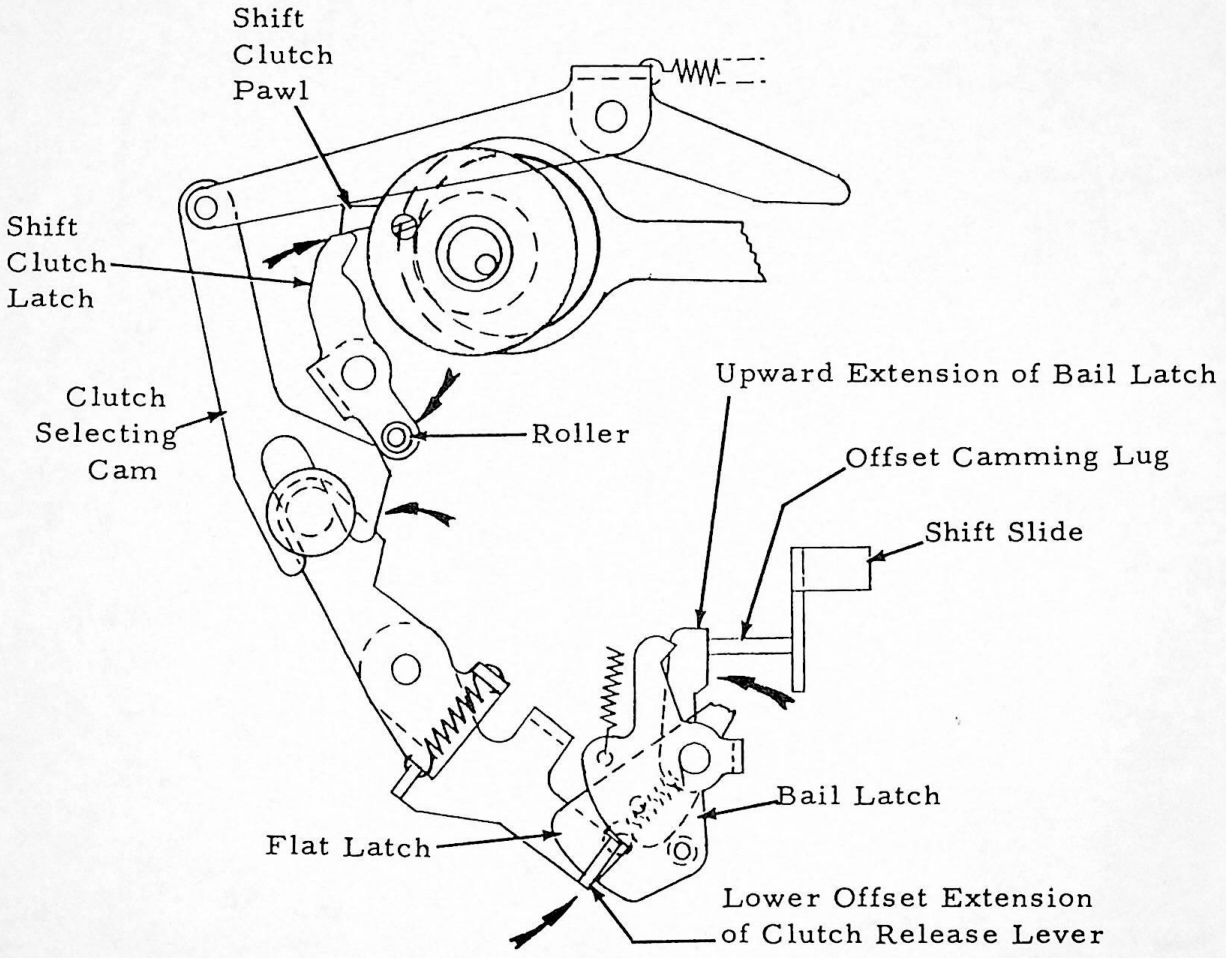


On the second half of this shift clutch cycle, the eccentric hub pushes its link to the rear...the upper shift pawl engages the inner ratchet gear, turning the worm shaft in a counter-clockwise direction which shifts the selector carriage one column to the right...into "home" position.

As the selector carriage moves into "home" position, its frame contacts the lug on the shift slide...pushing the shift slide to the right. The shift slide contacts the fishtail and pivots it back to where its upper camming edge again aligns with the upper operating lug of the shift pawl positioning plate.

Stopping the shift clutch....

While the selector carriage is being shifted into "home" position, the offset camming lug of the shift slide again contacts the upward extension of the bail latch... pivoting the bail latch in a counter-clockwise direction. The flat latch starts to pivot with the bail latch but, since its latching surface extends down further than the bail latch, its vertical edge contacts the side of the lower offset extension of the clutch release lever.



The pivoting of the bail latch thus opens the gap between the scissors latches and the lower offset extension of the clutch release lever is pulled by its spring into this gap.... This pivots the clutch selecting cam out of engagement with the roller of the shift clutch latch. The shift clutch latch is pulled by its neutralizing spring into the path of the shift clutch pawl, where it will stop the cycling of the shift clutch... completing the operation of the high speed mechanism.

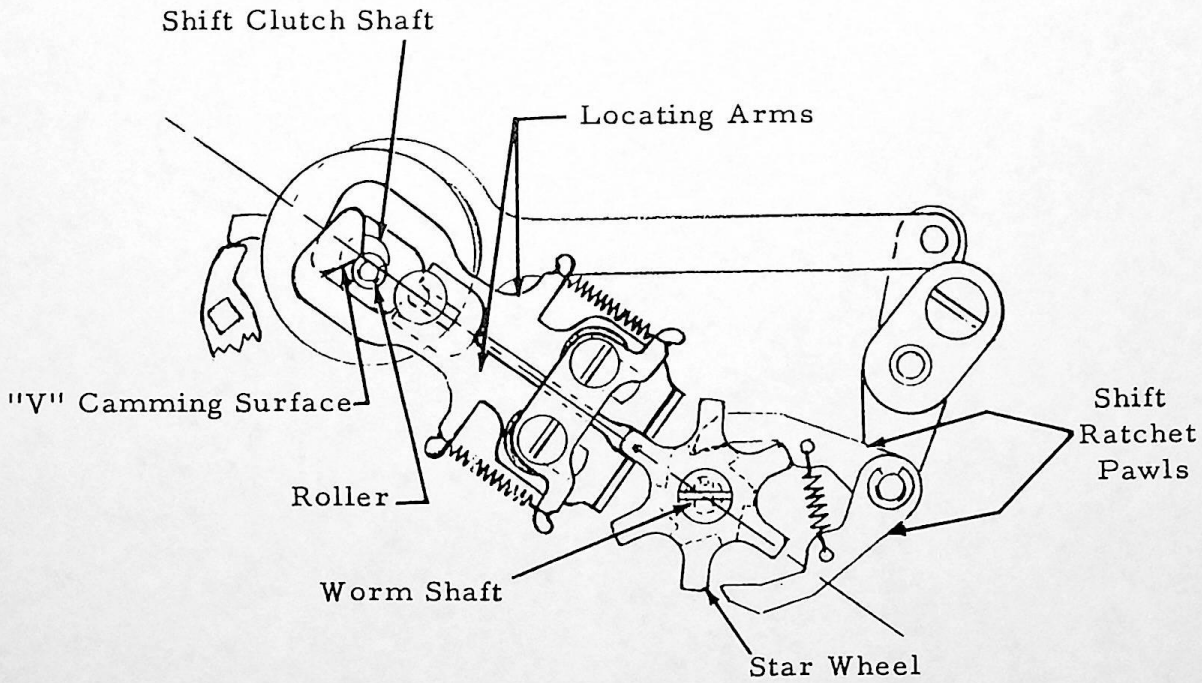
Worm Shaft Locator

A "star-wheel" locator is provided on the right end of the shift worm shaft to insure a positive locating of the selector carriage wherever it is shifted. The star wheel is secured to the worm shaft and rotates with it when the worm shaft is turned by the shift ratchet pawls.

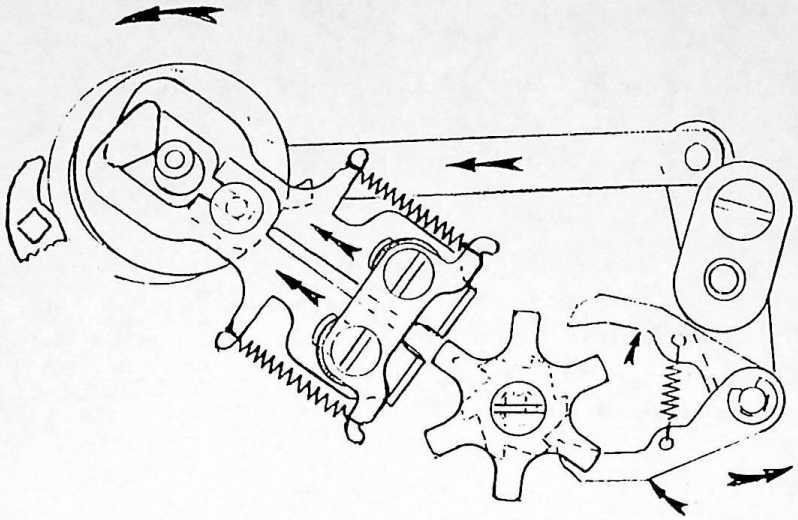
The star wheel is "locked" in each position by a pair of locating arms whose lower lugs position on either side of the "active" star wheel tooth. The locating arms lie parallel to an angular centerline thru the shift clutch shaft and worm shaft. They are slotted so that they can move up and down in the direction of this centerline.... Normally, they are spring held downward in locking position on the star wheel.

The upper ends of the locating arms each have a "V" shaped camming surface which aligns with the centerline thru the shift clutch shaft. On the first half cycle of a shift clutch rotation the roller on the eccentric extension of the shift clutch shaft raises the locating arms out of engagement with the star wheel.... As the worm shaft and star wheel are turned by the shift pawl, the locating arms are gradually lowered by the eccentric roller.
NOTE: The action of the eccentric roller lags behind the action of the eccentric hub on the shift clutch.... This provides time for the shift pawl to start the star wheel turning before the locating arms are lowered.
One locating arm will move down into the path of the star wheel tooth which is turning toward it. The other locating arm rides the top of the star-wheel tooth until it has passed under it... at which time it is pulled down behind the tooth.

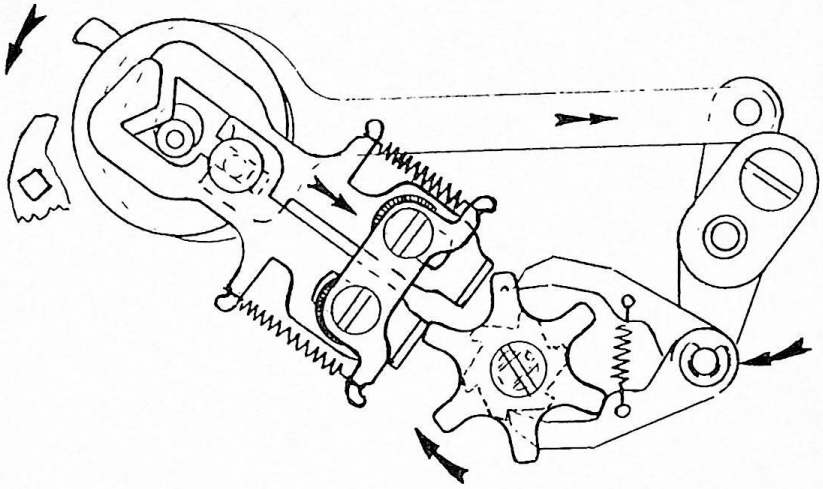
The illustrations show the action of the mechanism on a right to left shift... moving the selector carriage from "home" position one column to the left.



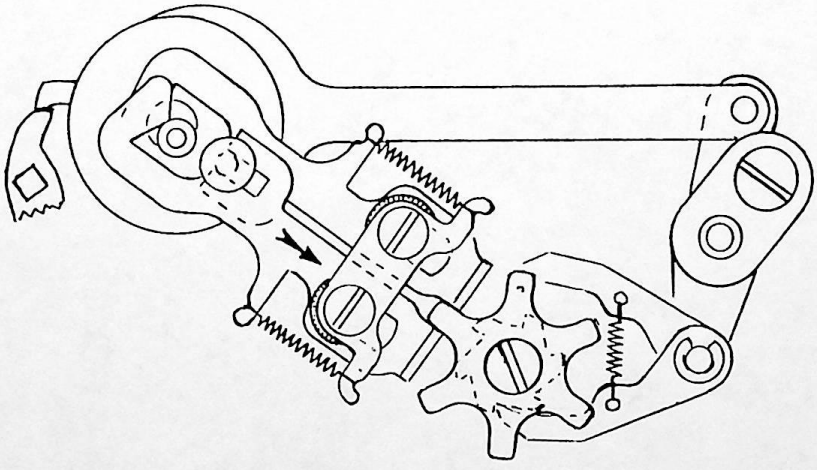
Normal Position....Star wheel "locked" in position by lower lugs of locating arms.



½ Cycle Position. . . . Eccentric roller raises locating arms out of engagement with tooth of star wheel.



Cycle continues and one locating arm is pulled into the path of next star wheel tooth as the other locating arm rides top of tooth. . . .



End of cycle. . . . As star wheel tooth locates against the lowered locating arm, the other locating arm is pulled down behind the tooth. . . locking star wheel and worm shaft in shifted position.

Example No. 2 ... ~~Primary~~ Selective Carry

Example: 6 × 2 = 12

The multiplicand (6) was entered in the first setable gear at the right end of the selector by the × key.... The multiplier (2) was entered in the first column of the multiplier/quotient gears on the first machine cycle of this multiplication operation. (Note that the multiplier (2) is the same as in the first example).

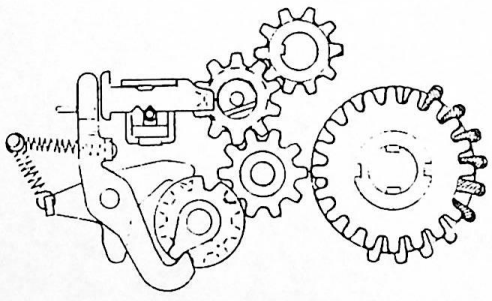
Review....

When the "T" arm raised the sensing bails, the first column multiplier sensing finger was pivoted counter-clockwise by its spring until it contacted the "middle position" section of the M/Q gear cam. This moved the sensing finger extension forward so that its raised surface will hold the shift/cycle sensing bail up in " cycle" position when the "T" arm releases the sensing bails. (First column sensing finger extension is held upward by the raising cam on the selector carriage frame).

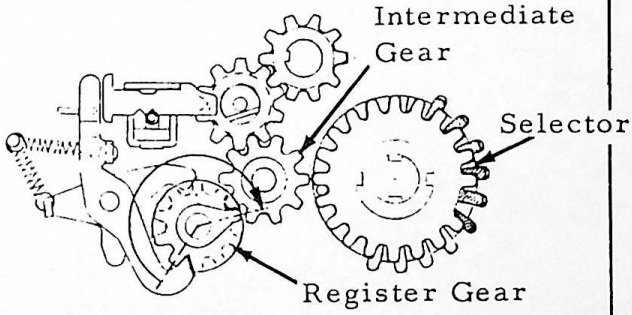
The shift slide latch was moved down into the notch of the shift slide by the "T" arm ...and is held there by the active first column sensing finger holding the multiplier sensing bail and shaft pivoted when the "T" arm is released.

With the multiplier sensing bail shaft held pivoted, the hold-up engaging arm keeps the hold-up link in blocking position to prevent release of the hold-up latch.

The clutch selecting cam, activated by the clutch starting bail, trips the cycle clutch. As the cycle clutch rotates, it turns the selector... adding the multiplicand (6) to the first column register gear. (The six teeth in the "true amount" zone of the first column setable selector gear turn the register intermediate gear, which displaces the register gear six teeth in a clockwise direction away from its zero position).



Register Gear at "O"
Before First Selector Cycle



Register Gear at "6"
After First Selector Cycle

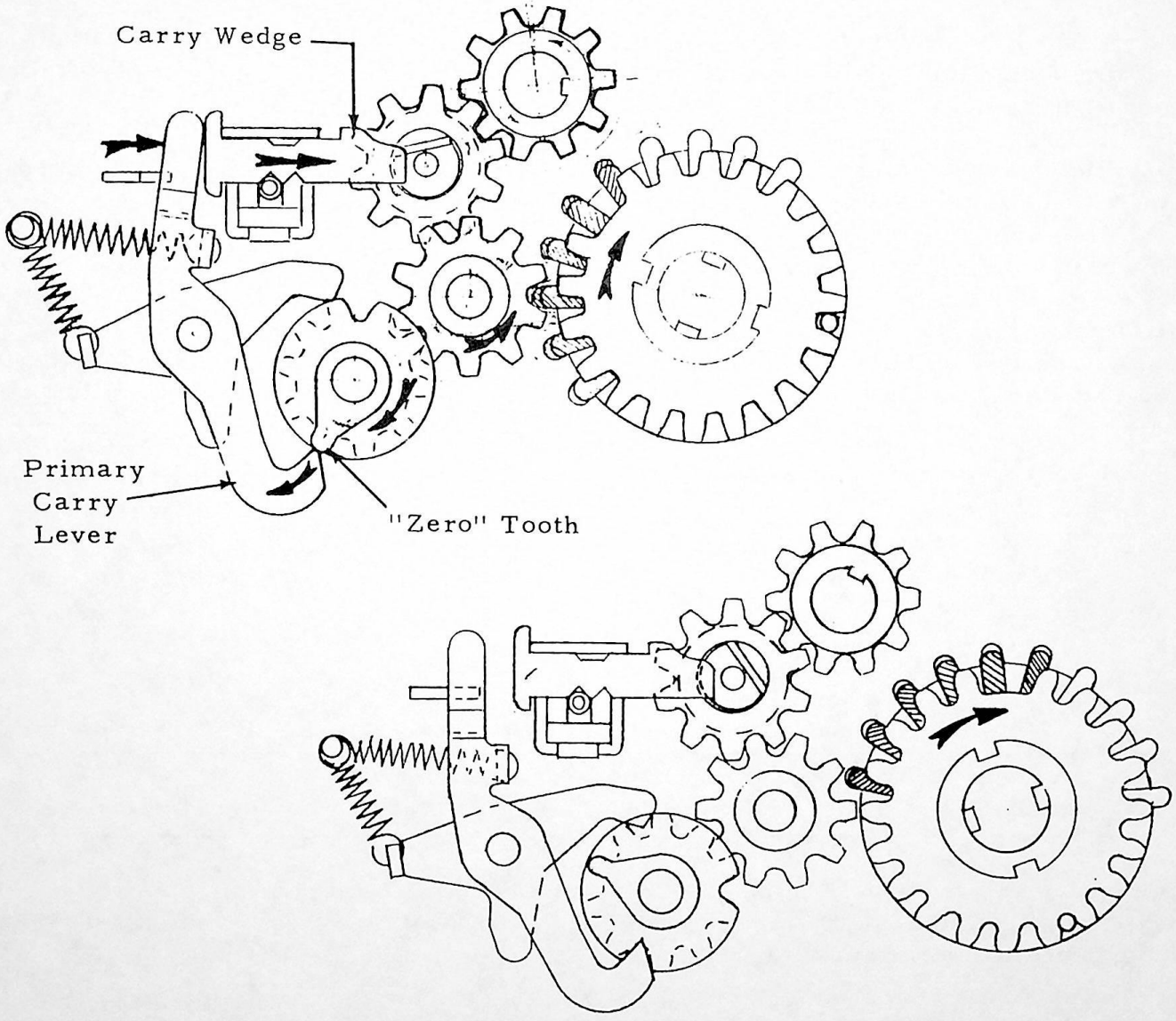
The rotation of the cycle clutch also rocks the counting pawl shaft and the lower counting pawl detents the counting gear shaft which results in the first column M/Q gear being counted back from "2" to "1".

The first column sensing finger is still holding the shift/cycle sensing bail up in "cycle" position... keeping the cycle clutch tripped so that it will rotate once more.

As the cycle clutch rotates a second time it turns the selector which again adds the multiplicand (6) to the first column register gear. Since the register gear has ten teeth, and was previously displaced six teeth away from its zero position, this second displacement of six teeth will move it around thru zero position and two teeth further. So we can say the first column register gear will then contain a "2".

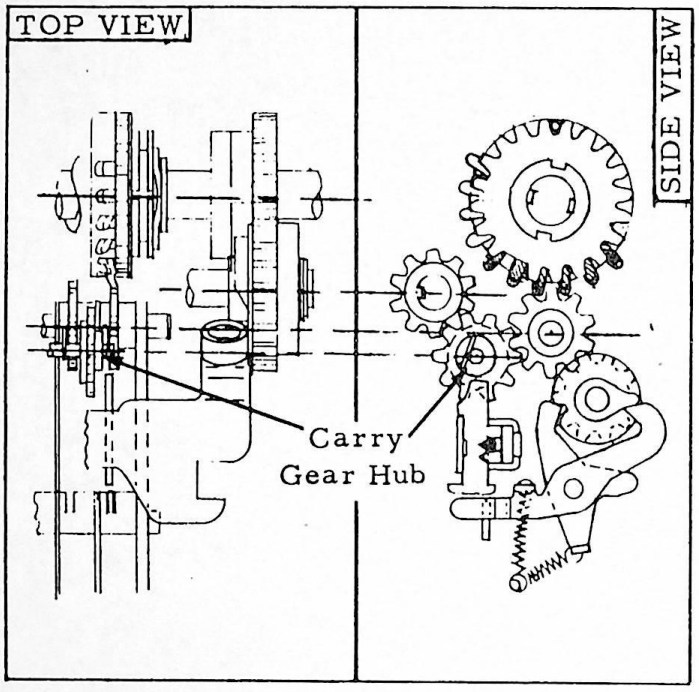
Primary Carry Lever....

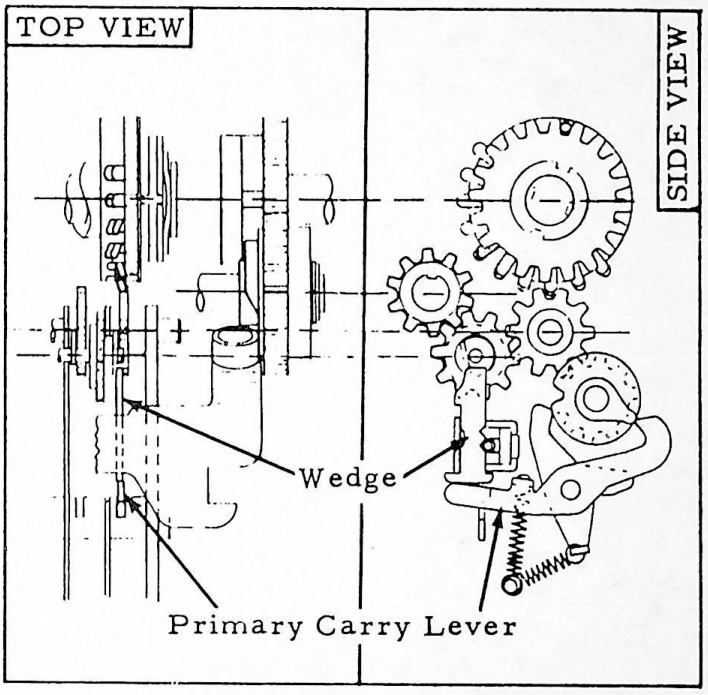
On the right side of the register gear is a single "zero" tooth. (This zero tooth was referred to previously (Page V-D-33) concerning its function in totaling the register). On the second six tooth displacement of the register gear...as it moves from "nine" to "zero" position...the zero tooth contacts the primary carry lever and rocks it in a clockwise direction. As it is rocked, its upper end contacts a "carry wedge" and pushes the wedge to the rear. (This wedge is carried in an assembly called the "wedge unit"). The primary carry lever is then immediately restored to its normal position by its spring....The wedge remains rearward.



Wedge Unit...

The wedge unit is located directly forward of the carry gears. It contains twenty "carry wedges" and a detent spring for holding the wedges in position. These wedges have two detent notches in their lower edge. They are normally positioned forward so that the detent spring locates in the rear notch and holds the wedge in its forward position. When a primary carry lever is rocked, the wedge is pushed to the rear (carry position), and held there by the detent spring locating in the forward notch.





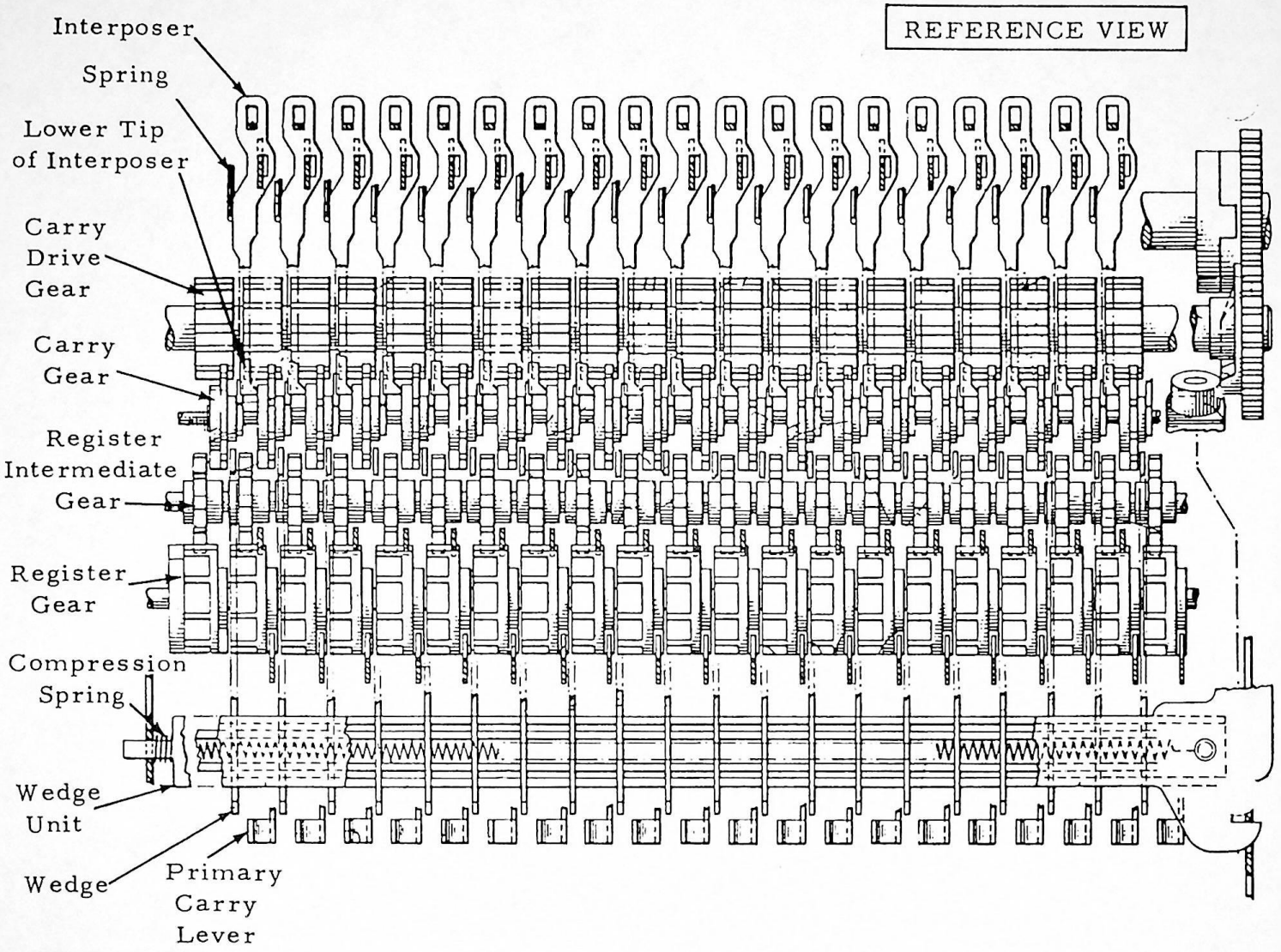
When a wedge is pushed rearward to carry position, its rearward end aligns to the right of a hub on the carry gear.... With a wedge in its normal position, its rearward end lies forward of this hub on the carry gear.

The wedge unit is moveable laterally....It has a roller on its right end which rides on a cam on the inside face of the carry drive gear. A compression spring at the left end of the wedge unit holds the unit to the right so that the roller stays in contact with the cam.

Carry Drive....

Whenever the cycle clutch rotates, the gear on the cycle clutch shaft turns the gear on the carry drive shaft. The gear on the carry drive shaft is keyed to the shaft... so the shaft also turns. There are twenty carry drive gears on the carry drive shaft and they are likewise keyed to the shaft. The keyway of the carry drive shaft is slightly spiraled to stagger the load of multiple carrys.

REFERENCE VIEW



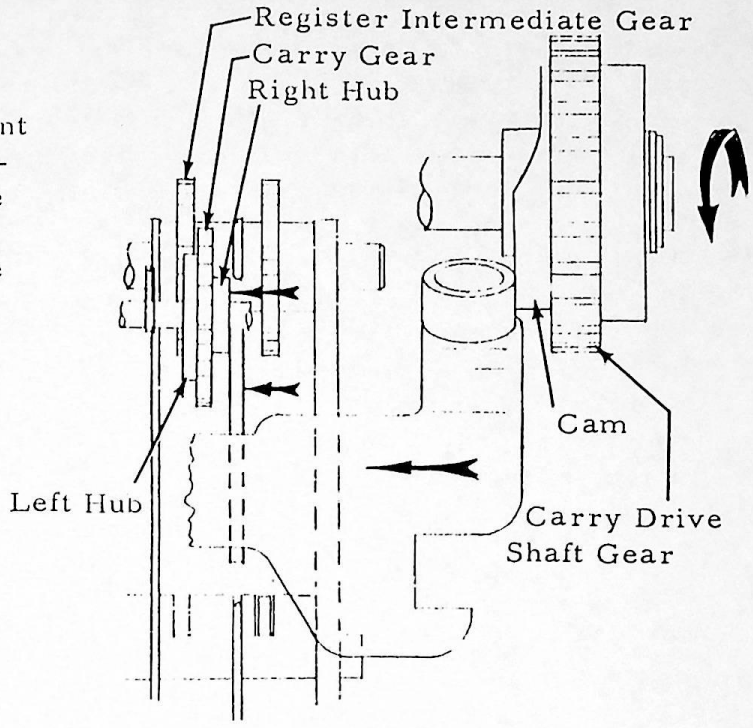
Note: In this reference illustration the components have been spread out from front to rear to clarify the relationship of the various gear units.

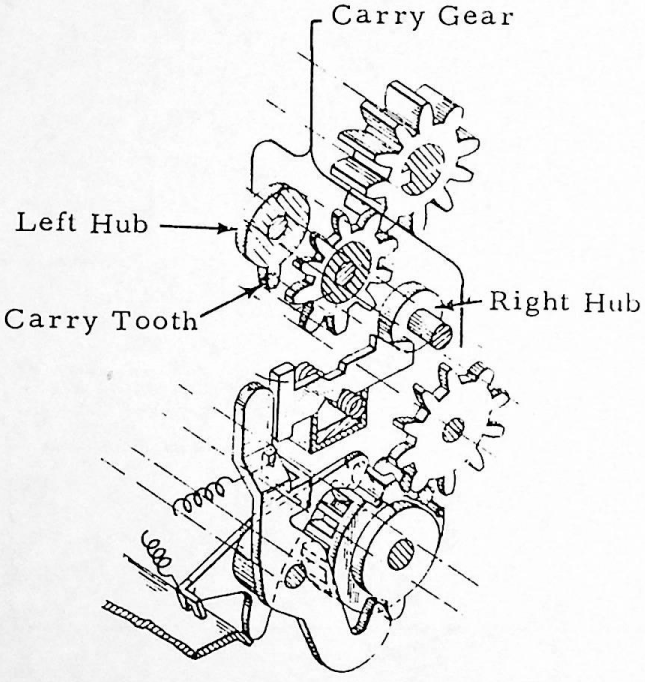
The carry drive gears are meshed with the carry gears of which there are also twenty. The drive gears have wide teeth and their lateral position is fixed. . . . The carry gears have narrow teeth and they can move laterally while in mesh with the wide teeth of their drive gears. The carry gears are normally held to the right. The left end carry gear is held to the right by a spring on the carry gear shaft. All the other carry gears are held to the right by the lower tips of the "transitional carry interposers". These interposers have two vertical positions. . . up or down . . . and they are normally held in the "up" position. The interposers can also pivot at the point where their upper ends fit thru the slots in the carry unit frame. They are normally held pivoted to the right by springs and in this position their lower tips hold the carry gears to the right.

Note: The function of these interposers will be covered in the next example (Transitional Carry). . . . For now it is enough to know that the spring tension on the interposers holds the carry gears to the right regardless of whether an interposer is in its up or down position.

· Wedge Unit Shift to Left....

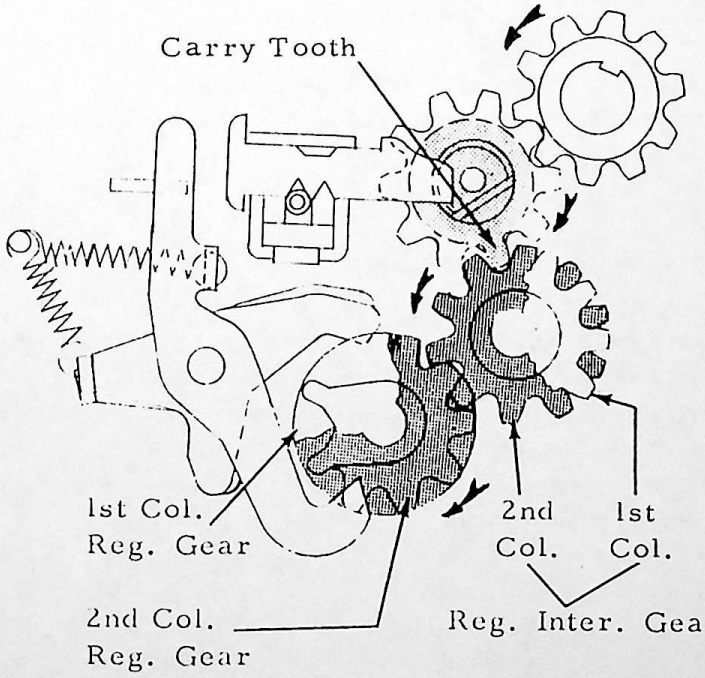
When the selector has rotated to the point where its teeth have past the area of engagement with the register intermediate gears, the cam on the inside face of the carry drive shaft gear pushes the wedge unit to the left. As the wedge unit shifts to the left the wedge that had been displaced to carry position contacts the hub on the right side of the carry gear and moves the carry gear to the left.





Carry....

The left side hub of the carry gear contains a single "carry tooth". The movement of the carry gear to the left moves this carry tooth into lateral alignment with the second column register intermediate gear. This occurs just before the carry tooth on the rotating carry gear reaches the area of the intermediate gear teeth.

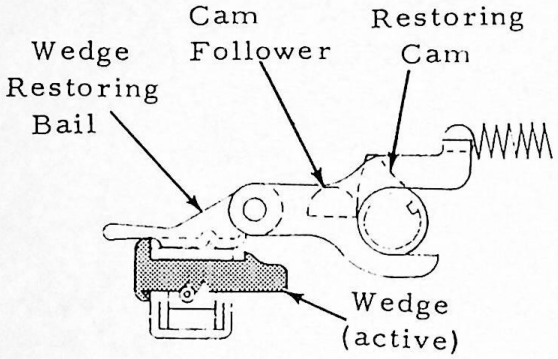


The carry tooth then displaces the intermediate gear one tooth in a counter-clockwise direction and the intermediate gear displaces the second column register gear one tooth in a clockwise direction. The second column register gear is thus moved from "0" to "1".

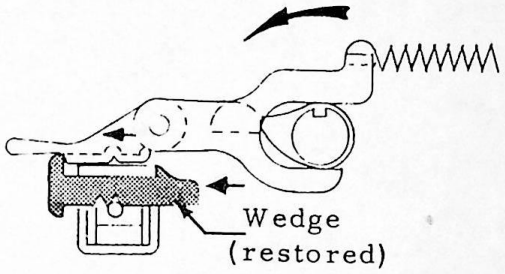
On this second selector cycle the first column M/Q gear was counted back from "1" to "0"... releasing the multiplier sensing bail which ends the calculating phase of the operation. The register contains the product (12) of the multiplication and this will be removed as the machine goes thru the product cycle as previously described.

Wedge Restoring....

Wedges that have been set to carry position are restored by a bail which rides on the flat top of the wedge unit and extends along its full length. Each end of this bail connects to a cam follower. The cam followers are operated by cams which are located on the carry drive shaft at either end of the group of carry drive gears. These restoring cams are keyed to the shaft.



This view shows the mechanism just before start of restoring movement. (near end of selector cycle).



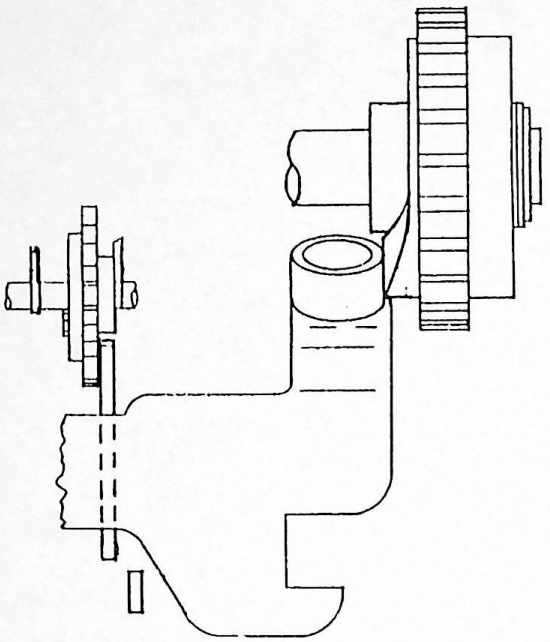
This view shows the mechanism at maximum restoring movement (at beginning of next selectorcycle.

The wedge restoring movement "overlaps" selector cycles.... That is, it starts at the very end of each selector cycle and is completed at the beginning of the next selector cycle (even if the next cycle doesn't occur until some later operation).

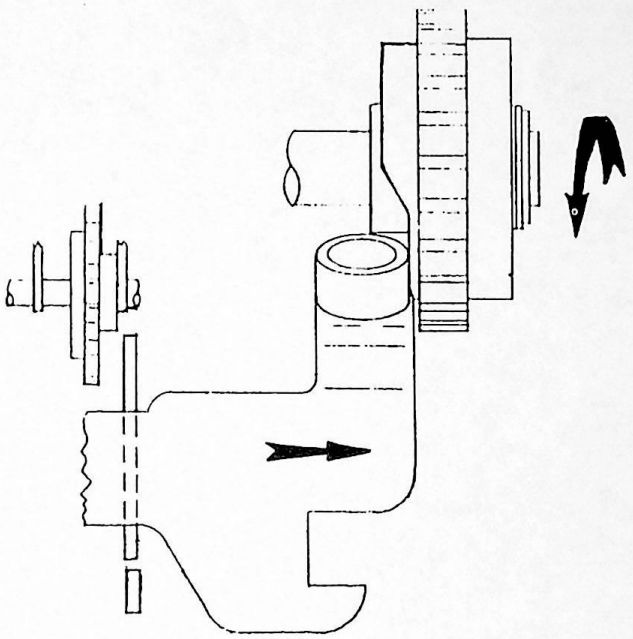
The wedge restoring bail is held rearward by springs on the cam followers which hold the cam followers in contact with the restoring cams... Near the end of a selector cycle, the cam lobes start to push their followers and the restoring bail forward. The forward edge of the restoring bail engages the upward projecting lug of any wedge that had been detented to carry position and starts to push the wedge forward. This movement continues thru the beginning of the next selector cycle and the wedges are thus restored to their normal position.

Wedge Unit Shift to Right....

Since the wedge unit was shifted to the left for the carry...which occurs near the end of the cycle...it remains in this left position whenever the cycle clutch is neutralized. It must be shifted back to the right, therefore, to align the forward ends of the wedges with the primary carry levers and the rearward ends to the right of the carry gear hubs.

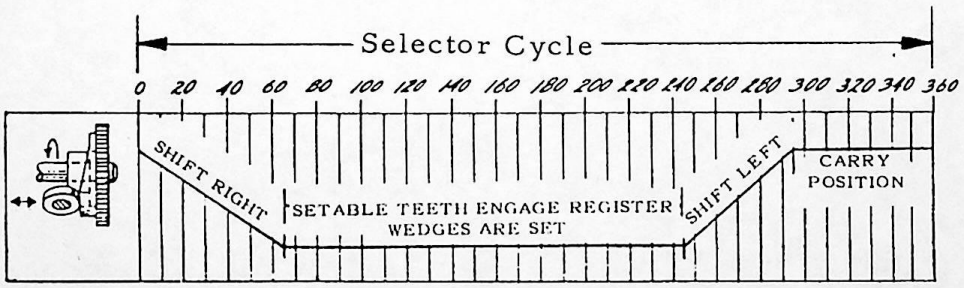


Wedge Unit Shifted Left
(Neutral)



Wedge United Shifted Right

This right shift occurs at the very beginning of a selector cycle...as the high lobe of the cam on the inside face of the carry drive shaft gear moves away from the roller on the wedge unit. The wedge unit is then pushed to the right by its compression spring.


Selector Cycle
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360
SHIFT RIGHT
SETABLE TEETH ENGAGE REGISTER WEDGES ARE SET
SHIFT LEFT
CARRY POSITION

Wedge Unit Shift Diagram

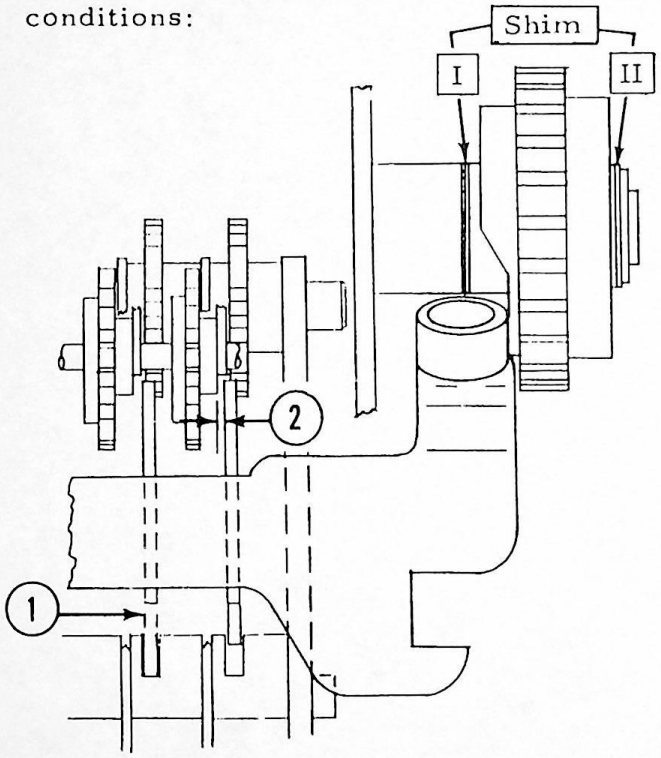
Adjustment

The gear on the carry drive shaft must be shimmed to remove all end play from the shaft and to adjust the lateral relationship between the wedges and the carry gears....

The part number of the shim washer used is 92084....It's dimensions are: .005 wide, 5/16" outside diameter, 7/32" inside diameter.

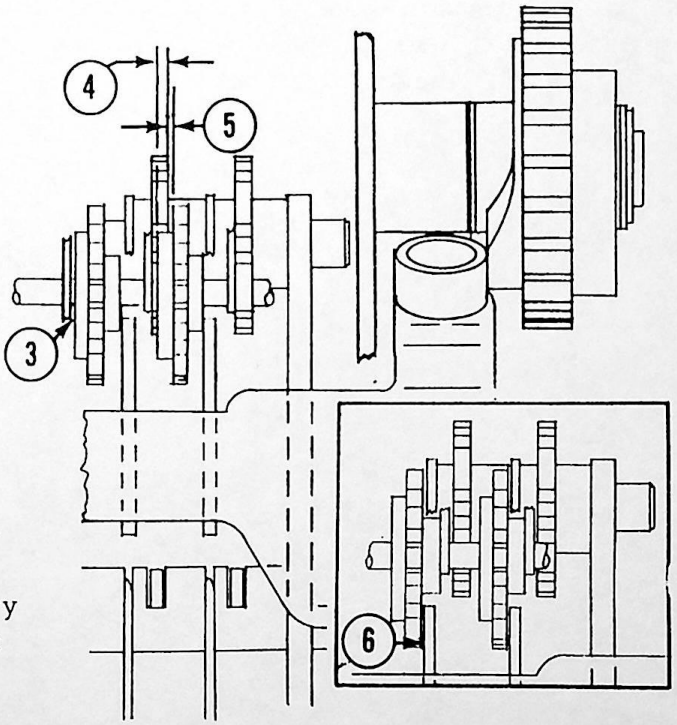
I First, determine the amount of shim washers required:
Trip cycle clutch and rotate mechanism until wedge unit shifts to the right....Remove retainer and install enough shims on outside of gear to remove end play, without binding shaft.

II Now adjust the lateral relationship between wedges and carry gears by transferring enough shims from the outside to the inside of the gear to obtain the following conditions:



A. With wedge unit shifted to the right:
1. Wedges should align with upper extensions of primary carry levers
2. With wedges detented to carry position, they should have from .010 to .020 clearance to right of carry gear hub.

B. Continue rotating clutch until wedge unit shifts to the left (stop before wedge restoring movement starts).



3. Carry gears must not cramp against partition plates of carry unit.
4. Carry tooth of carry gears should have from .037 to .042 engagement with register intermediate gears.
5. The other teeth of the carry gear should have from .005 to .010 clearance to right of register intermediate gears.
6. Check that wedges do not move carry gears when carry unit is shifted left with wedges in restored position.

Example No. 3.... Transitional Carry and Short-Cut Multiplication

Transitional Carry....

The previous example described the function of the primary carry mechanism .... When a register gear was turned from "9" to "0", it caused a wedge to be set to carry position. The wedge unit was then shifted to the left, moving the carry tooth of the carry gear into alignment with the register intermediate gear in the next left column... resulting in that register gear being "carried" one tooth, near the end of the cycle.

Now suppose the register gear that received the carry had been at "9".... The carry would have turned it to "0"... necessitating a carry out of that column into the next left column. If this next column register gear were also at "9", then it too would have to carry to the next one, and so on thru any other progressively adjacent columns to the left which contained "9's".

Since it would not be mechanically possible to utilize the primary carry setting mechanism in such instances... a "transitional" carry mechanism is used. This mechanism provides for a simultaneous carry into the next left column from any gear that is carried from "9" to "0".

While this transitional carry mechanism functions in both regular multiplication and short-cut multiplication, it is utilized to a much greater extent in short-cut. Therefore, the description of "transitional carry" and "short-cut mult." have been combined in this example.

Short-Cut Multiplication....

The previous examples, both described regular multiplication operations.... The multiplicand ("true amount" in the selector) was added to the register the number of times it takes to count the multiplier digit (in the M/Q gears) backwards to "0". This is the manner in which the machine functions when a multiplier digit is "5" or less. When a multiplier digit is "6" or more, the machine performs short-cut multiplication to lessen the number of cycles required.

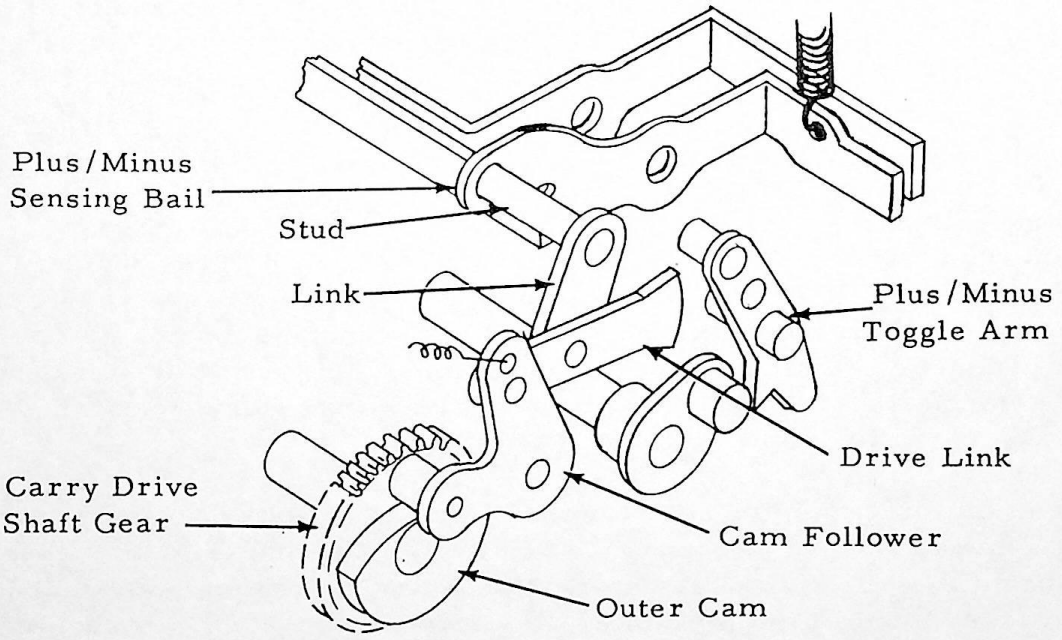
In short-cut multiplication the selector is positioned in "minus" alignment with the register intermediate gears (see Page V-B-26) and the complement of the multiplicand (also in the selector) is added to the register the number of times it takes to count the multiplier digit forward to "0". The selector is then shifted one column left. On the first half cycle of the shift clutch a "short-cut carry" is added to the next left column M/Q gear.

Example: 2 × 6 = 12

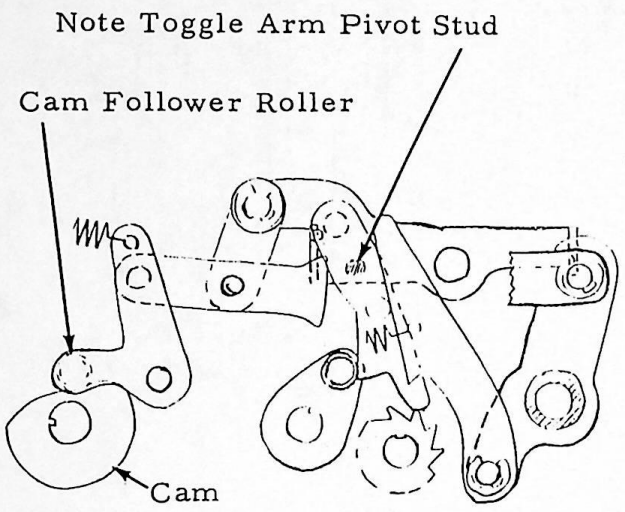
The multiplicand (2) was entered in the first setable gear at the right end of the selector by depressing the × key. The complement of the multiplicand (99999999999999999998) is also in the selector. . . . The multiplier (6) was entered in the first column M/Q gear on the first machine cycle of this multiplication operation. (Note that the factors are the same as in the previous example. . . but their positions are reversed).

When the "T" arm raised the sensing bails, the first column multiplier sensing finger was pivoted counter-clockwise by its spring until it contacted the low section of the M/Q gear cam. (See illustrations on Page V-D-37). This moved the sensing finger extension forward so that its raised surface will hold both the shift/cycle sensing bail and the plus/minus (short-cut) sensing bail upward when the "T" arm releases the sensing bails. (The first column sensing finger extension is held upward by the raising cam on the selector carriage frame. . . see Page V-D-38).

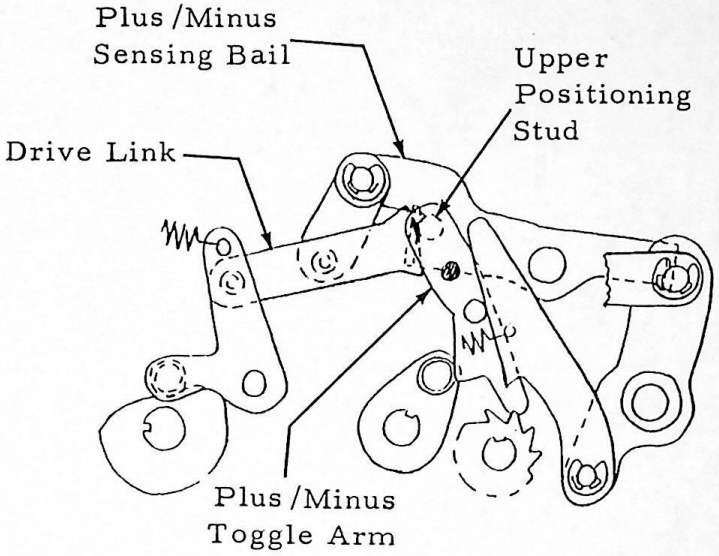
The plus/minus sensing bail contains a stud in the forward extension of its right end. This stud is connected by a link to the drive link for the plus/minus toggle arm. The drive link is connected to a cam follower which is operated by the outer cam of the carry drive shaft gear.



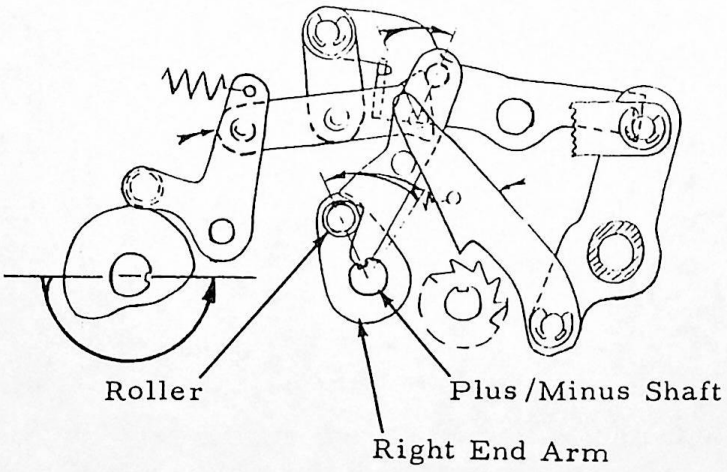
The cam follower roller normally rests in the low section of this cam.... At the beginning of the cycle clutch rotation, this cam follower is rocked in a clockwise direction by the high section of the cam. With the plus/minus sensing bail held upward, the drive link on the cam follower is aligned with the upper positioning stud on the plus/minus toggle arm. The clockwise rocking of the cam follower pushes the drive link rearward. The drive link contacts the upper positioning stud and pivots the toggle arm in a clockwise direction.



NEUTRAL POSITION



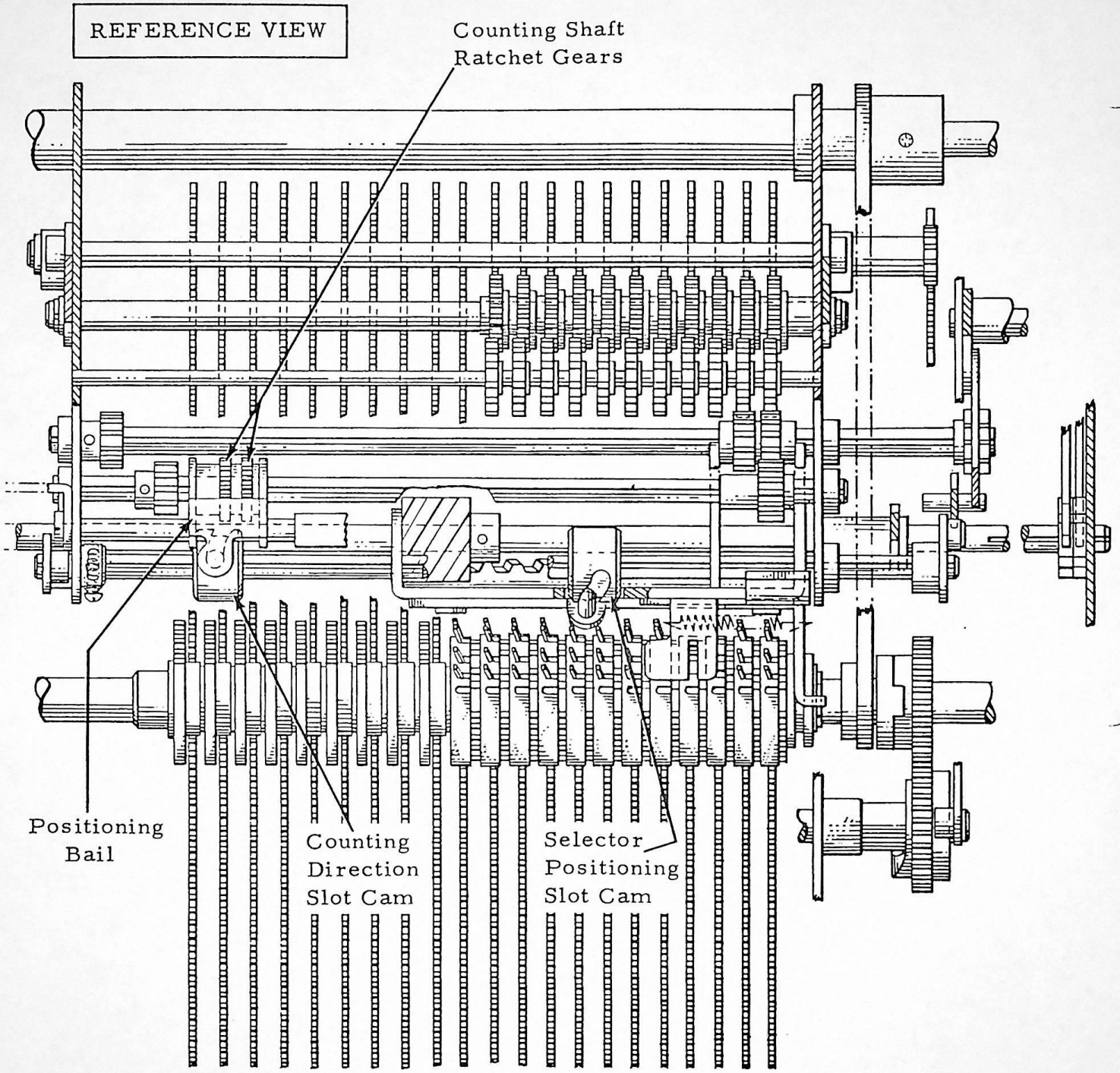
PLUS/MINUS BAIL RAISED



½ CYCLE POSITION - TOGGLE MADE

The lower extension of the toggle arm contacts the roller on the right end arm of the plus/minus shaft... rocking the shaft counter-clockwise to minus position. (NOTE: In this position the toggle is "made".... That is, it will hold the plus/minus shaft in minus position until such time as it is forced back into plus position by the drive link).

REFERENCE VIEW



As the plus/minus shaft moves to minus position, the selector positioning slot cam moves the selector positioning plate to the right so that the teeth in the "complement" zone of the selector are aligned with the register intermediate gears. Another slot cam is located on the plus/minus shaft in the area of the counting shaft ratchet gears. This cam slot is engaged by a stud on the positioning bail for the counting shaft ratchet gears. The rocking of the plus/minus shaft to minus position cams this positioning bail to the right. The bail moves the counting shaft ratchet gears to the right. This moves the right ratchet gear out of alignment with the lower counting pawl and the left ratchet gear into alignment with the upper counting pawl. (See Page V-D-44). With this alignment the M/Q gear will be counted forward instead of backward as in the regular mult. examples.

Short Cut.

Selector 23
Selector Comp. 999 77
M.Q. Dear 187

1st Col. −3 shortcut cycles.
2nd col −1 shortcut cycle.
3rd col. +2

00000
99977
99977
99977
99957
99977
99931
9977
99101
23
02001
23
7201

Selector 90
Selector Comp 999|0|10
M.Q. 58
1st col. −2
2nd col. −4
3rd col. +1

00000
99910
99910
99910
99820
99010
98920
99010
98020
99010
97120
99010
96220
90
95220

M.Q. 88
Selector 25
Selector Comp 99975
1st Col −2
2nd col −1
3rd col. +1

00000
99975
99975
99975
99950
99975
99700
25
00085000
002200

Selector 50
Selector Comp 99994 10
M.Q. 799
1st col −1
2nd col 0
3rd col −2
4th col +1

00000
99994 10
99950
9410
94950
9410
98995 0
50
39950

Selector 19
Selector Comp. 99961
M Q 559
1st col −1
2nd col −4
3rd col 0
4th col +1

00000
99981
95581
9981
99791
9581
99601
9981
99411
9981
99922 1
19
18 221

Selector 500
Selector Comp
M.Q. 109
1st Col. −1
2nd col. +1
3rd col. +1

00000
99500
9900
0088200
00000
99500
99400
500
00800
500
98900

Selector 0
Selector Comp. 99990
M.Q. 9
1st col −1
2nd col +1

00000
99990
00000
00000
00000

Selector 1012
Selector Comp 99898
M.Q. 496
1st Col. −4
2nd col 0
3rd col. +5

00000
98998
98686
98898
97978
98988
96964
99988
99955 8
5660
05019 58

Selector 120
Selector Comp 98710
M.Q. 209
1st col −1
2nd col +1
3rd col. +2

00000
98710
99880
120
001080
240
02 5080

On the first selector cycle the complement of the multiplicand is added to the register:

Register	00000000000000000000
Selector (-)	99999999999999999998
Register	99999999999999999998

The M/Q gear was counted forward from "6" to "7".

The selector cycles a second time...adding the complement to the register again.

Register	99999999999999999998
Selector (-)	99999999999999999998
Reg.(before carry)	88888888888888888886
Add carries	11111111111111111111
Register	99999999999999999996

Since all register gears were turned thru the "9"/"0" segment by the selector, all the wedges were detented to carry position. Therefore all the "carries" shown above were primary carries (as indicated by the arrows from above).

The M/Q gear was counted from "7" to "8".

The selector cycles a third time...again adding the complement to the register.

Register	99999999999999999996
Selector (-)	99999999999999999998
Reg.(before carry)	88888888888888888884
Add carries	11111111111111111111
Register	99999999999999999994

Again, all carries are "primary"....The M/Q gear is counted from "8" to "9".

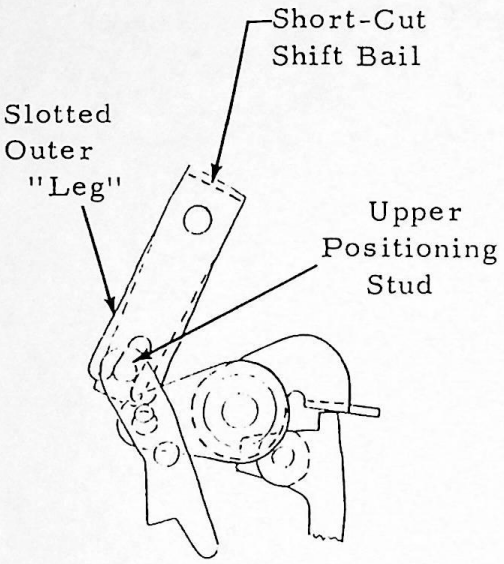
The selector cycles a fourth time...again adding the complement to the register.

Register	99999999999999999994
Selector (-)	99999999999999999998
Reg.(before carry)	88888888888888888882
Add carries	11111111111111111111
Register	99999999999999999992

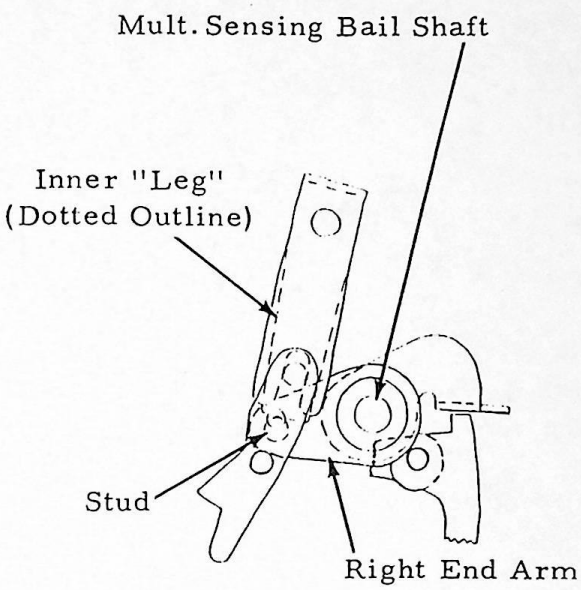
Again, all carries are "primary"....The M/Q gear is counted from "9" to "0".

As the M/Q gear is moved to "0" it cams the multiplier sensing finger in a clockwise direction. The raised surface of the sensing finger extension moves out from under the shift/cycle and plus/minus sensing bails and these bails pivot counter-clockwise to their normal positions.

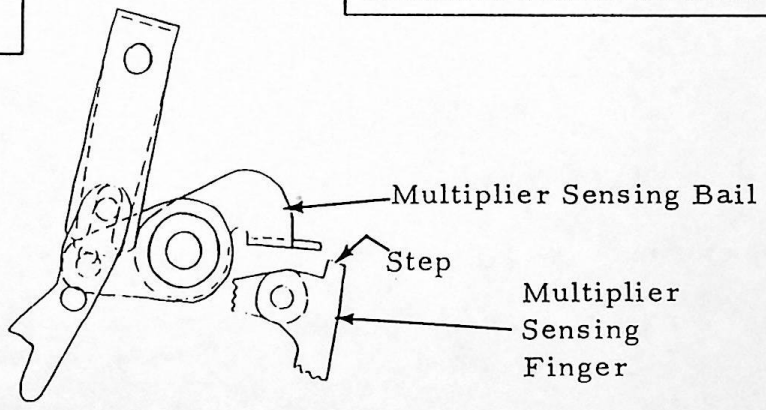
When the multiplier sensing finger was pivoted by the M/Q gear moving to "0" the step on top of the sensing finger moved out from under the multiplier sensing bail. . . . This bail, however, does not restore to its neutral position. It is held active by the "short-cut shift bail".



TOGGLE ARM "PLUS"
(Before being driven
into "Minus" position)



TOGGLE ARM "MINUS"
SENSING FINGER ACTIVE

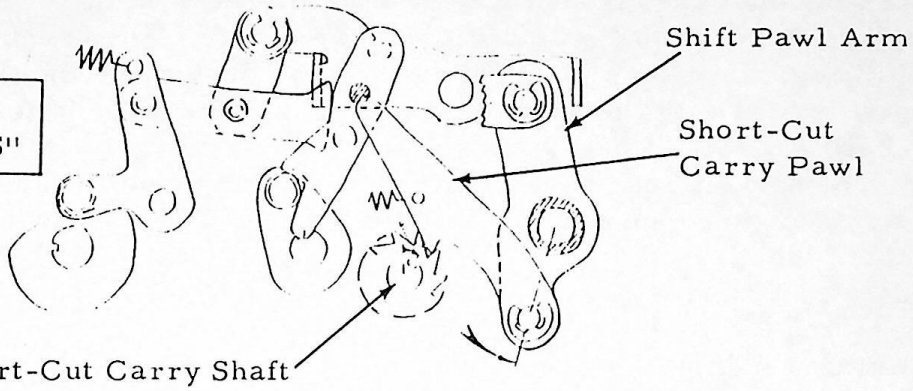


TOGGLE ARM "MINUS"
SENSING FINGER RESTORED
Multiplier Sensing Bail Remains Active

The short-cut shift bail has a slotted outer "leg" which fits over the upper positioning stud on the plus/minus toggle arm. Whenever the toggle arm is driven clockwise to minus position, the short-cut shift bail is pivoted counter-clockwise. When this bail pivots counter-clockwise its inner "leg" positions over the stud in the right end arm of the multiplier sensing bail shaft. Therefore, when the sensing finger moved out from under the multiplier sensing bail, the bail was prevented from restoring by the short-cut shift bail.

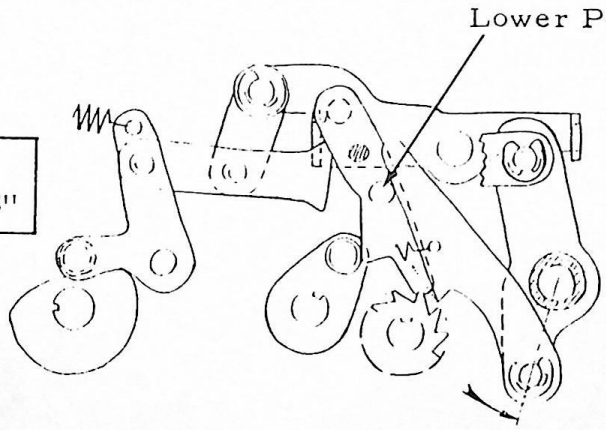
The restoring of the shift/cycle sensing bail moves the clutch selecting cam down. . . . This trips the shift clutch.

HALF SHIFT CYCLE
TOGGLE ARM "MINUS"



On the first half cycle of the shift clutch the shift pawl arm is rocked counter-clockwise. A "short-cut carry pawl" is connected to the shift pawl arm. . . and, as the shift pawl arm rocks counter-clockwise, this short-cut carry pawl engages a ratchet gear on the right end of the short-cut carry shaft. . . detenting the shaft one "tooth" in a clockwise direction.

HALF SHIFT CYCLE
TOGGLE ARM "PLUS"



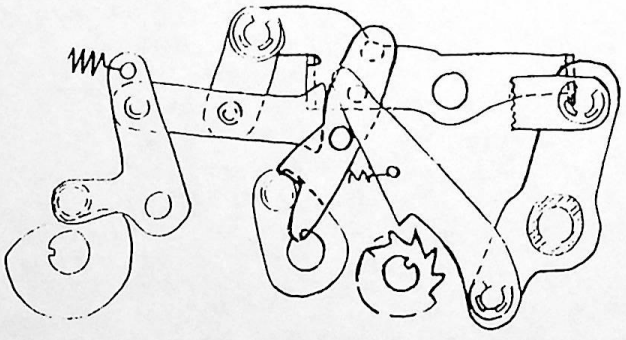
Note: This short-cut carry pawl is rocked by the shift pawl arm on every shift cycle. When the plus/minus mechanism is in plus position, it is held out of engagement with the ratchet gear by the outward extending end of the lower positioning stud on the plus/minus toggle arm. With the toggle arm in minus position, its lower stud is pivoted forward. . . permitting the short-cut carry pawl to be pulled into engagement with the ratchet gear by its spring.

A short-cut carry gear is keyed to the short-cut carry shaft (to the left of the intermediate counting gear... see Page V-D-44). This gear, like the counting gears, is trapped between the right end of the selector carriage frame and a bracket on the frame. It also slides laterally on its shaft with the movement of the selector carriage and it is always aligned with the M/Q intermediate gear in the column to the left of the one which is being counted out. In this example, the first column M/Q gear has been counted out and the short-cut carry gear is aligned with the second column M/Q intermediate gear. Therefore, as the short-cut carry shaft is detented one tooth clockwise by the short-cut carry pawl, the short-cut carry gear turns the second column M/Q intermediate gear one tooth counter-clockwise... and the intermediate gear turns its M/Q gear one tooth clockwise.

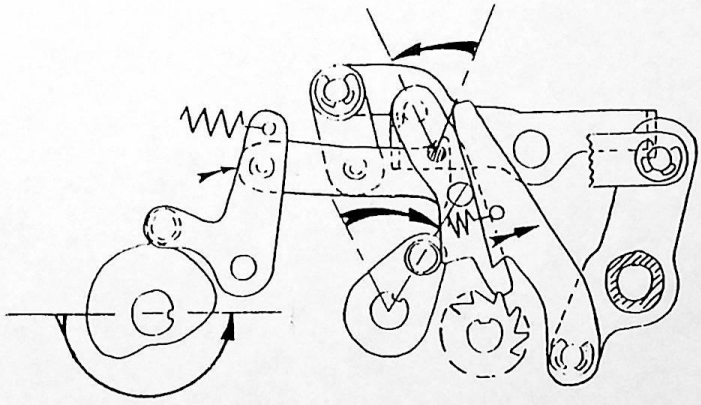
This moves the second column M/Q gear from "0" to "1"... and the second column multiplier sensing finger is pivoted by its spring in a counter-clockwise direction until it contacts the "middle position" section of the M/Q gear cam.

On the second half of the shift clutch cycle the selector is shifted one column left... and the raising cam on the right end of the selector carriage raises the second column multiplier sensing finger extension. The raised surface of this sensing finger extension is positioned under the shift/cycle sensing bail (but not the plus/minus sensing bail). The shift/cycle sensing bail is therefore raised and the clutch selecting cam trips the cycle clutch....

As the cycle clutch starts to turn, the drive link for the plus/minus toggle arm is cammed rearward. This drive link had been lowered into alignment with the lower positioning stud on the plus/minus toggle arm when the plus/minus sensing bail was restored. Therefore, as the drive link moves rearward, it contacts this lower positioning stud and pivots the toggle arm in a counter-clockwise direction... breaking the toggle.



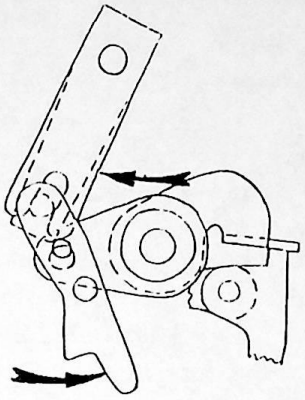
CYCLE CLUTCH NEUTRAL
TOGGEL ARM "MINUS" (Made)



HALF CYCLE OF CYCLE CLUTCH
TOGGLE ARM "PLUS" (Toggle 'Broken')

As the toggle arm pivots, the outward extending end of its lower positioning stud pivots the short-cut carry pawl out of engaging alignment with the short-cut carry shaft ratchet gear.

Also, as the toggle arm pivots, its upper positioning stud pivots the short-cut shift bail out of engagement with the stud in the right end arm of the multiplier sensing bail shaft. . . . The multiplier sensing bail, however, is now prevented from restoring by the active second column multiplier sensing finger.



Note: It has been stated previously that the multiplier entry capacity is ten digits . . . . You have seen that after a short-cut digit (6 thru 9) is counted out, a short-cut carry occurs which adds "1" to the next left column M/Q gear. An eleventh column M/Q gear is provided to receive the short-cut carry which will occur when the tenth column M/Q gear contains a short-cut digit. This is the only reason for the eleventh column M/Q gear. It is not intended to receive direct entries.

The possibility does exist however, that, because of some malfunction, a digit might be entered in the eleventh column M/Q gear. To prevent the setting of the plus/minus toggle arm to minus position, in the event that a short-cut digit was in this eleventh M/Q gear, the slot in the upper guide comb for the eleventh multiplier sensing finger is shorter than the slots for the other ten fingers. This short slot will prevent prevent the sensing finger from moving forward enough to raise the plus/minus sensing bail. . . . Therefore, regardless of what the digit is, it will always be counted backwards to zero and the short-cut shift bail will not be activated.

The plus/minus shaft is returned to plus position by the restoring spring on its left end arm. This restores the selector to "plus" alignment with the register intermediate gears and aligns the "backward" counting ratchet with the lower counting pawl.

As the selector cycles, the "true amount" is added to the register:

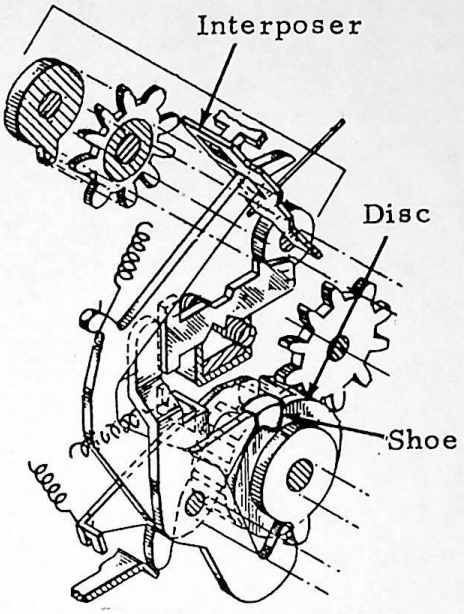
Register	99999999999999999992
Selector (+)	2
Reg. (before carry)	99999999999999999912
Add carries	11111111111111111111
Register	00000000000000000012

Note: arrows pointing down from above carry "1" indicate primary carry. . . . Arrows pointing up from below "1" indicate transitional carry.

Since the second colum register gear was the only one turned thru the "9"/"0" segment by the selector, the carry into the third column was the only primary carry. . . . With all the other register gears to the left at "9", they were all simultaneously carried to "0" by the transitional carry mechanism.

Transitional Carry....

The register gear teeth on the left side of the gear are separated from the single "zero" tooth on the right side by a disc. This disc has a single notch in its periphery. The "shoe" of a transitional sensing lever rides the periphery of the register gear disc under light spring tension. The upper end of this transitional sensing lever engages a slot in a transitional carry interposer. When a register gear is at any position from "0" thru "8" its disc keeps the transitional sensing lever raised which in turn, keeps its interposer raised. With the interposer in this "up" position, its lower tip rests against the larger diameter hub on the left side of the carry gear to its right...but is above the small diameter hub on the right side of the carry gear to its left.

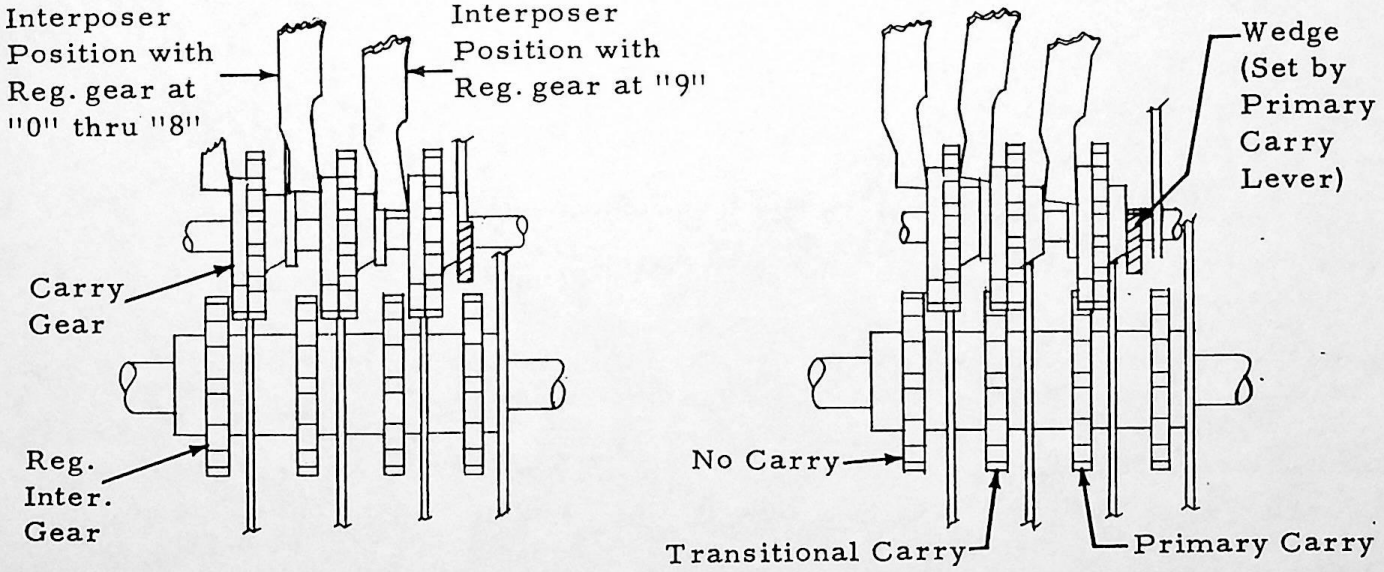


REGISTER GEAR AT "9"

When a register gear is turned to "9" by selector action, the transitional sensing lever is pivoted clockwise by its spring as its "shoe" enters the notch in the register gear disc. This moves the interposer down. With the interposer in this down position, its lower tip is positioned between the large diameter hub on the gear to its right and the small diameter hub on the gear to its left ....Therefore, if the carry gear on the right is moved to the left for a carry, the interposer fills the gap between the gears and the gear on the left is also moved to the left for a carry.

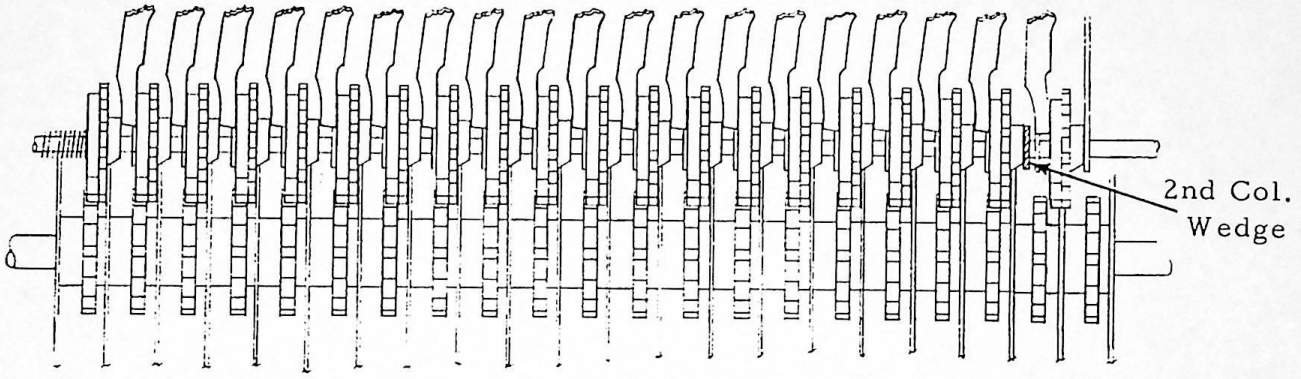
BEFORE WEDGE UNIT SHIFT

AFTER WEDGE UNIT SHIFT


Interposer Position with Reg. gear at "0" thru "8"
Interposer Position with Reg. gear at "9"
Carry Gear
Reg. Inter. Gear
Wedge (Set by Primary Carry Lever)
No Carry
Transitional Carry
Primary Carry

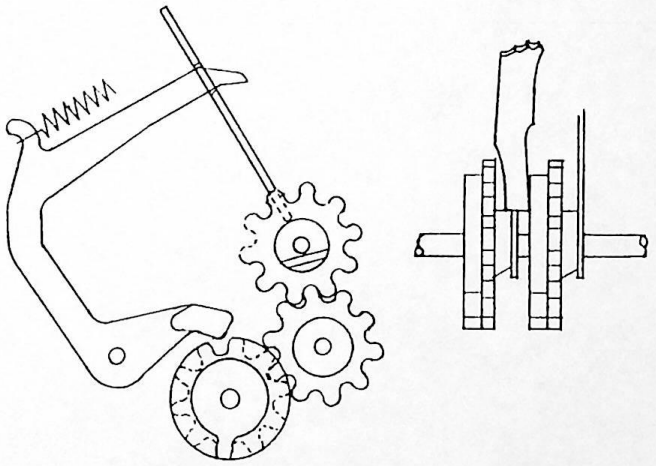
EXAMPLE OF A SINGLE TRANSITIONAL CARRY

In the example, when the second column register gear was turned thru the "9"/"0" segment by the selector, its zero tooth rocked the primary carry lever... setting the wedge to carry position. With all register gears to the left of this second column at "9", all their transitional sensing lever "shoes" were in the notches of the gear discs. These sensing levers had moved their interposers down to fill the gap between the carry gear hubs. Therefore, when the wedge unit was shifted to the left, the second column wedge moved its carry gear to carry position and all the other carry gears to the left were simultaneously moved to carry position.

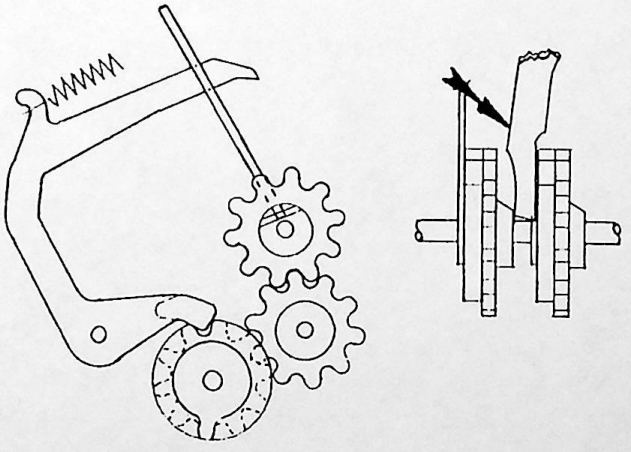


Carry Gear (right side hub)....

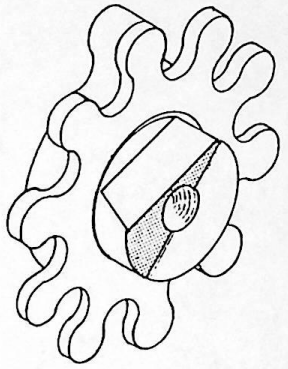
When a primary or transitional carry turns a register gear from "8" to "9", the notch in the register gear disc presents itself to the shoe of the transitional sensing lever. The lever starts to pivot into the notch but is stopped as its interposer contacts the shoulder of the carry gear hub. This prevents the shoe of the transitional sensing lever from entering the notch of the register gear disc... and the interposer is held against the shoulder of the carry gear hub under the tension of the transitional sensing lever spring.



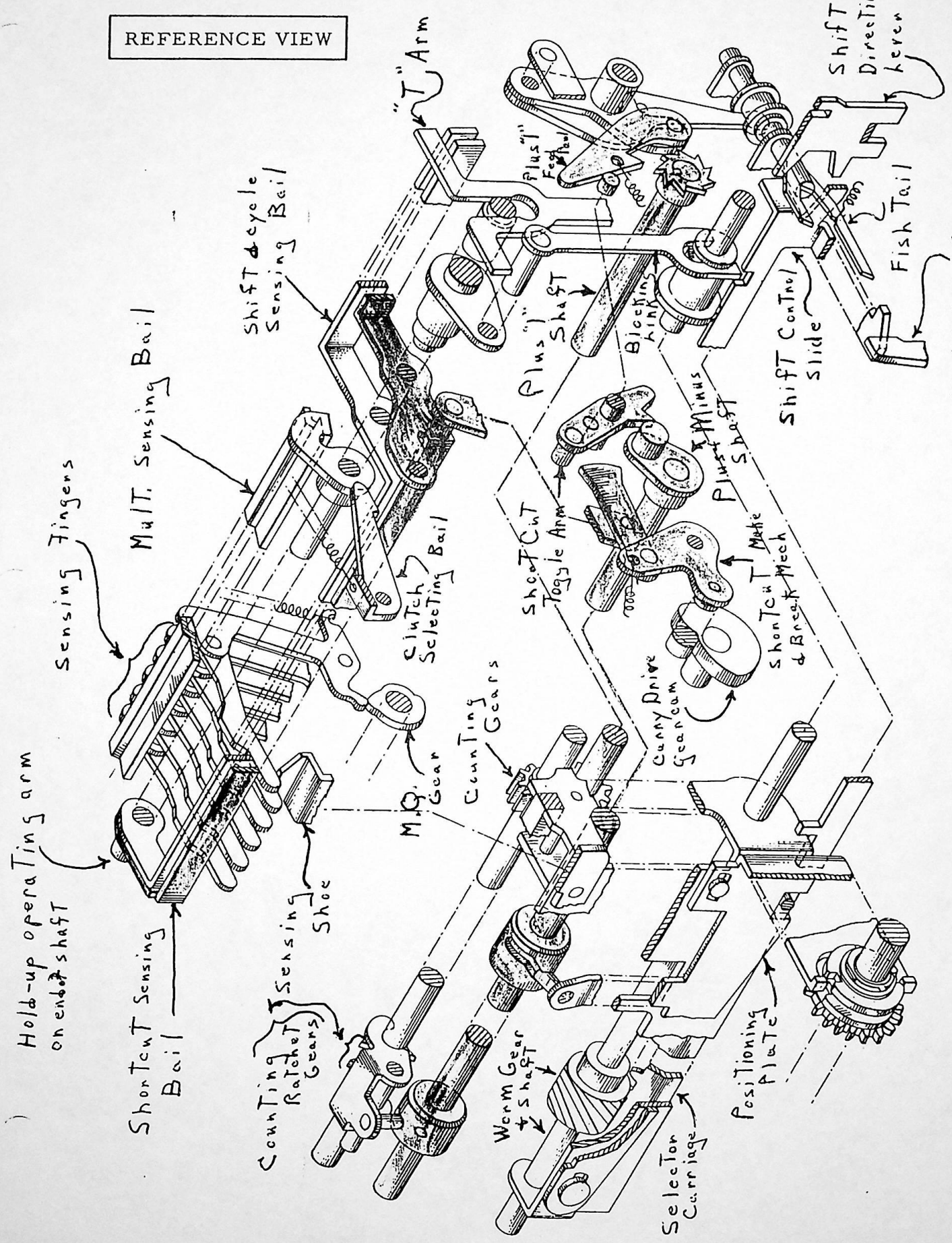
To insure that this interposer will move down and fill the gap between the gears before the carry phase of the next cycle, a portion of the right side hub of the carry gear is cut back at an angle from the face of the hub to the face of the gear. As the gear rotates and this portion of the hub reaches the interposer, the interposer will slide down the angular surface and fill the gap between the gears.



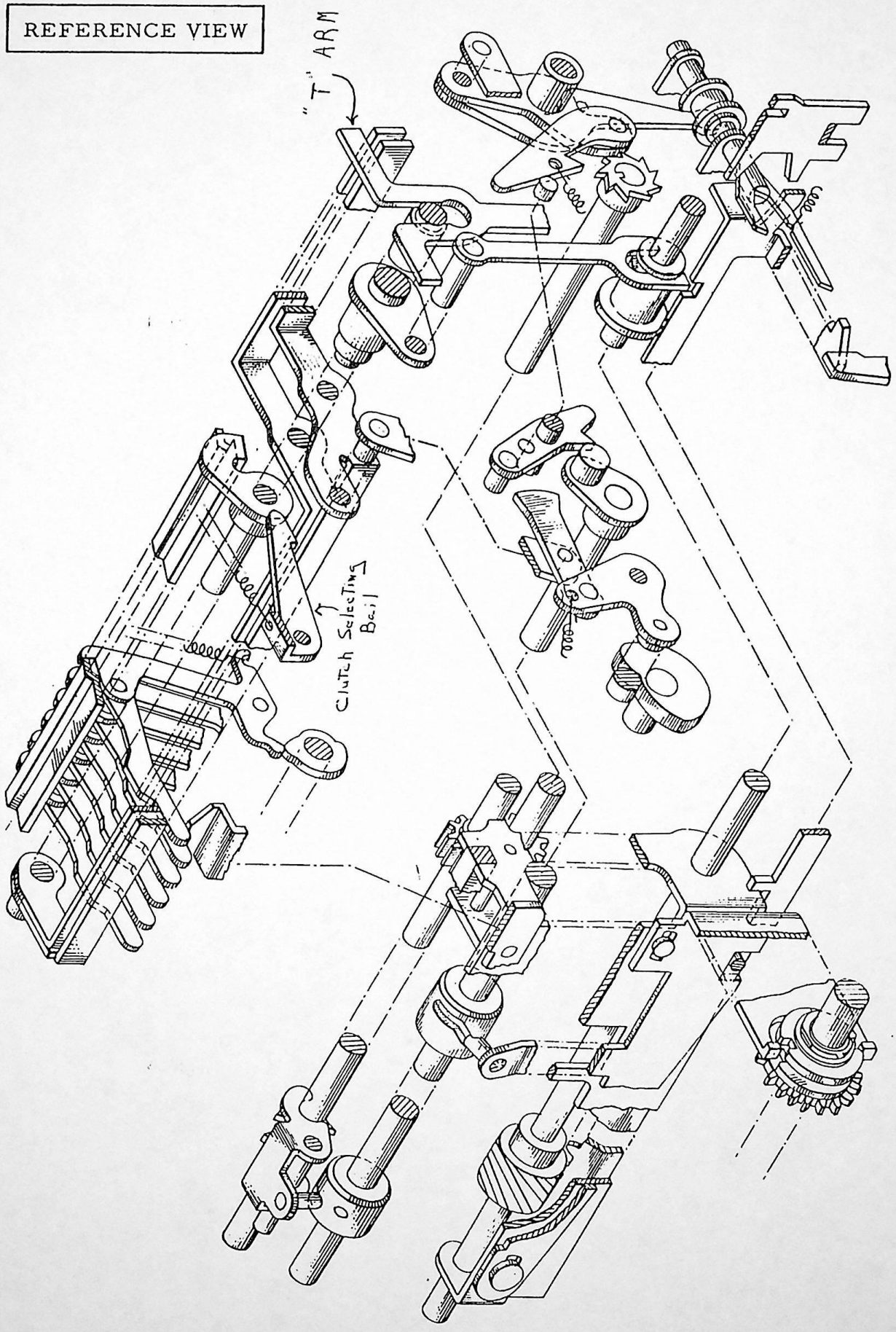
There is another very slight milled step cut across the face of this right side hub on the carry gear ....This cut is only .0015 to .002 deep. It provides the necessary clearance for an interposer to drop into the gap during that segment of the cycle when the selector is turning the register intermediate gears. Then, during the "carry phase", the interposers ride up the step and practically all lateral clearance is removed. With this arrangement, the movement imparted to a right end carry gear can be transmitted, almost without loss, thru the interposers and gears to the left end carry gear.



NOTES


REFERENCE VIEW
"T" Arm
Shift Direction Lever
"Plus" Feeler Pawl
Shift Cycle Sensing Bail
Mult. Sensing Bail
"Plus" Shaft
Blocking Link
Fish Tail
Shift Control Slide
Bail Latch of Scissors
Sensing Fingers
Clutch Selecting Bail
Shortcut Toggle Arm
"Minus" Plus Shaft
Shortcut Make & Break Mech
Hold-up operating arm on end of shaft
Shortcut Sensing Bail
Counting Ratchet Gears
Sensing Shoe
M.Q. Gear
Counting Gears
Cam Drive Gear Cam
Worm Gear & Shaft
Positioning Plate
Selector Carriage

REFERENCE VIEW



OPERATING PRINCIPLES

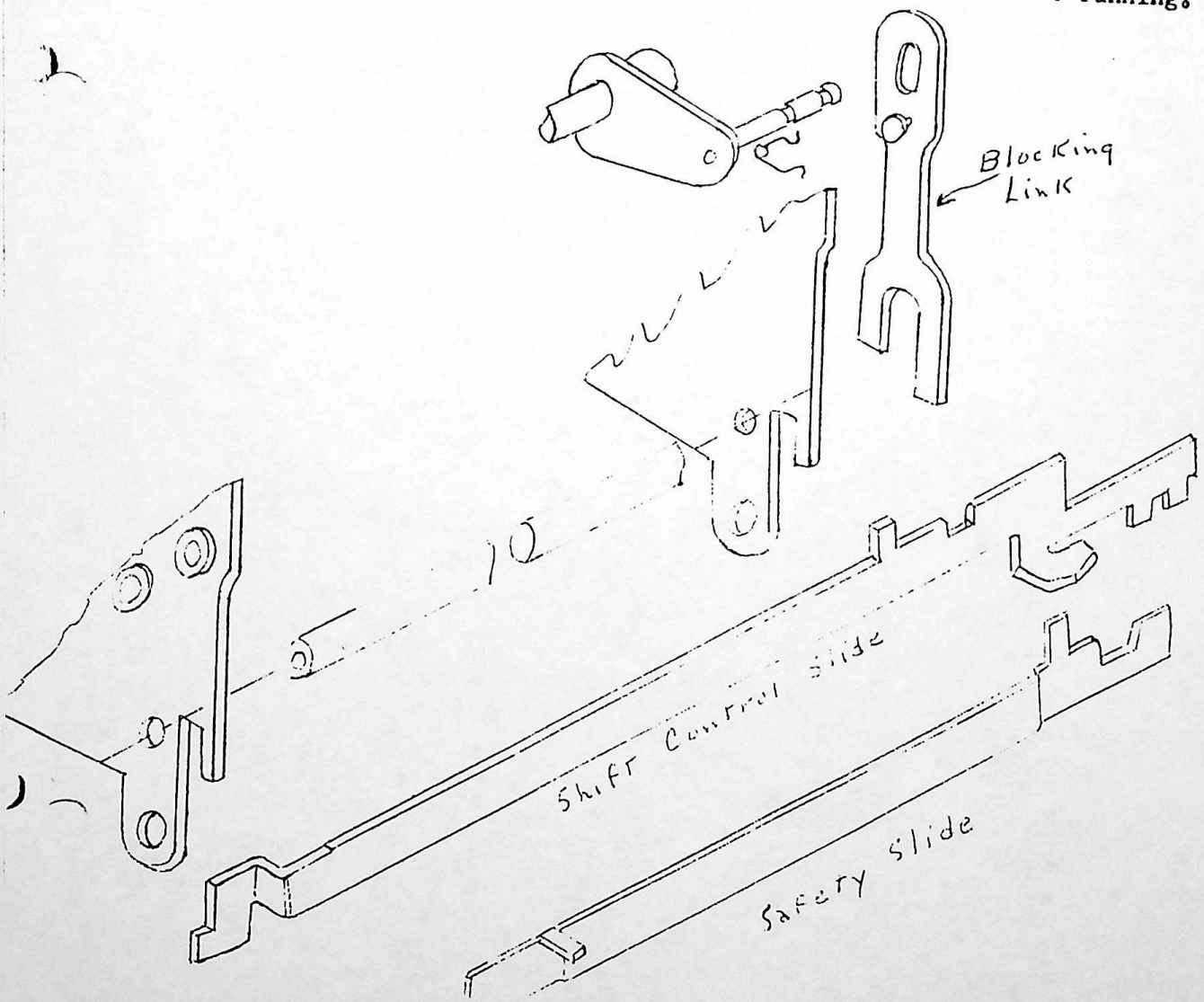
Safety slide (911086) has been added so that if the multiplier gears are not cleared or the short-cut bail is not restored the machine will not jam and strain or break the selector and/or the selector shift mechanism.

It works as follows:

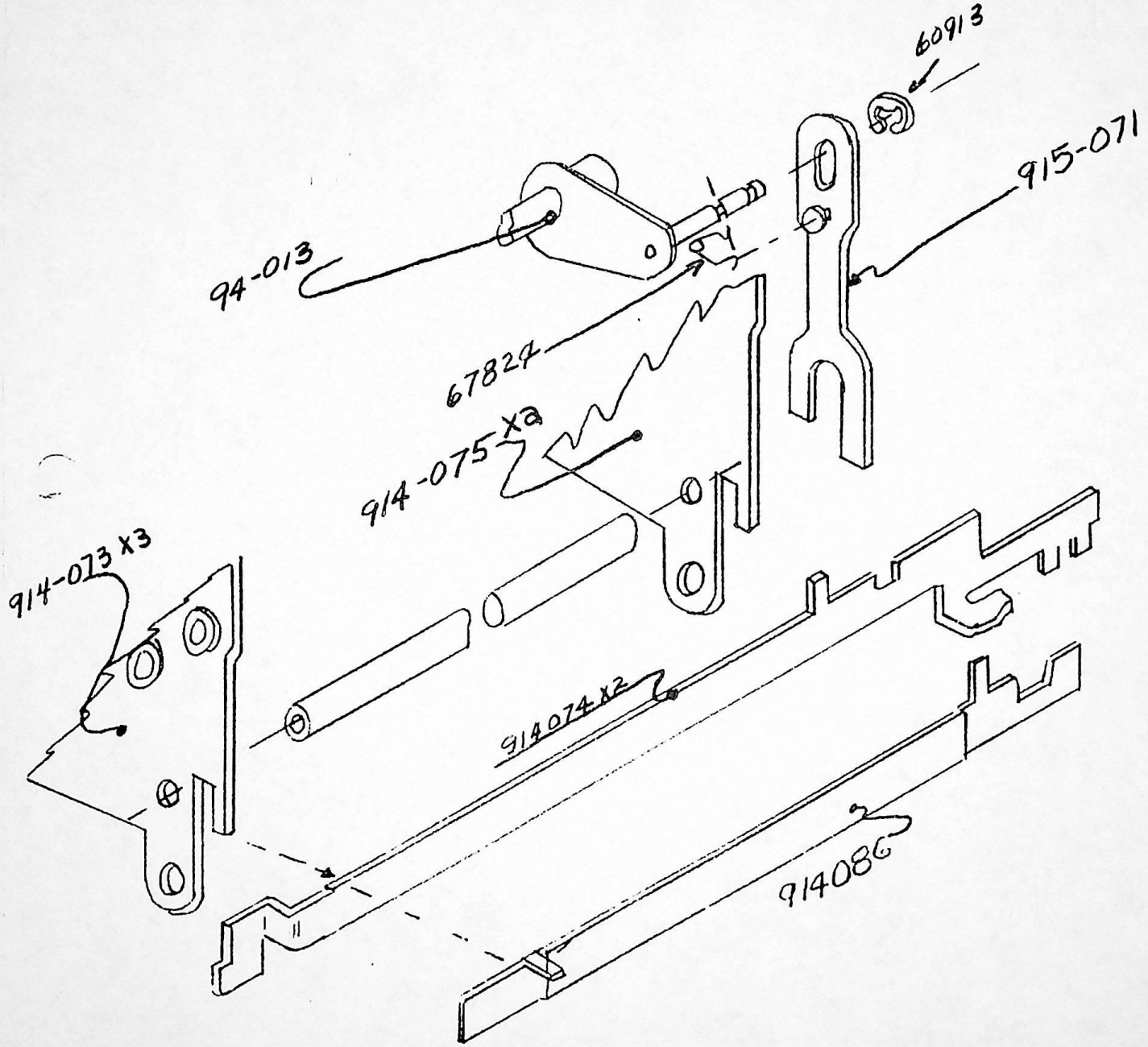
If, during multiplication, any sensing fingers remain active, or the short-cut bail remains latched; as the selector carriage moves into it's left most position it hits the left lug on the safety slide. This action pushes the safety slide to the left camming the blocking link upward (altered to yield thru a toggle spring), which permits the shift control slide to shift to the left releasing the "fishtail" which positions for a right shift.

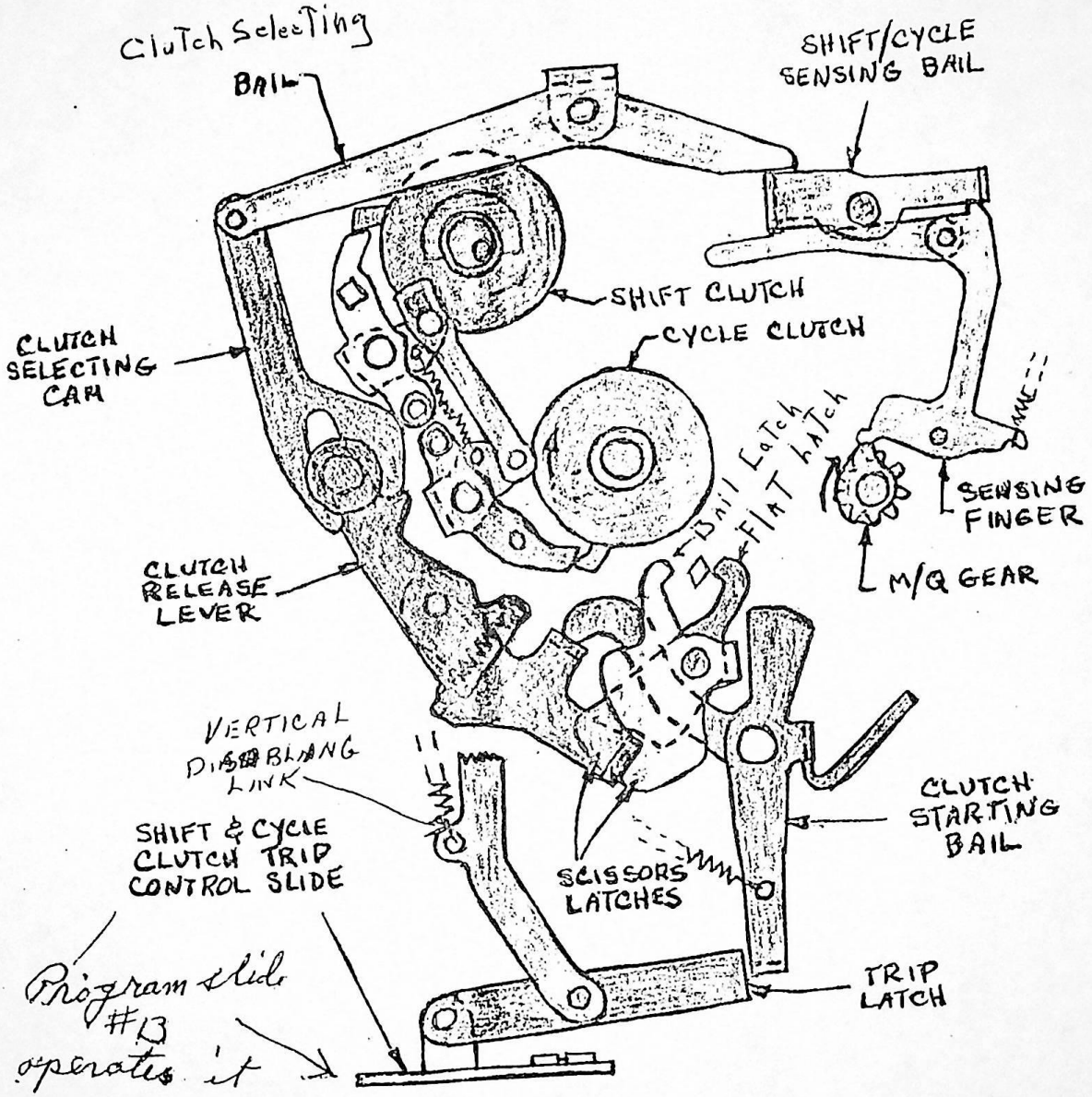
As the selector carriage shifts to the right it will stop and count out any columns that are active, but if a short-cut operation is involved, "carry" figures, due to the short-cut counting will remain in the multiplier gears.

Upon reaching the first column the shift mechanism will be neutralized as is normal, and if the multiplier gears are zeroed and the short-cut latch is inactive the machine will continue by taking a product total. If the multiplier gears are not cleared and/or the short-cut latch is active, the machine will remain in the 30° hold-up position with the motor running.

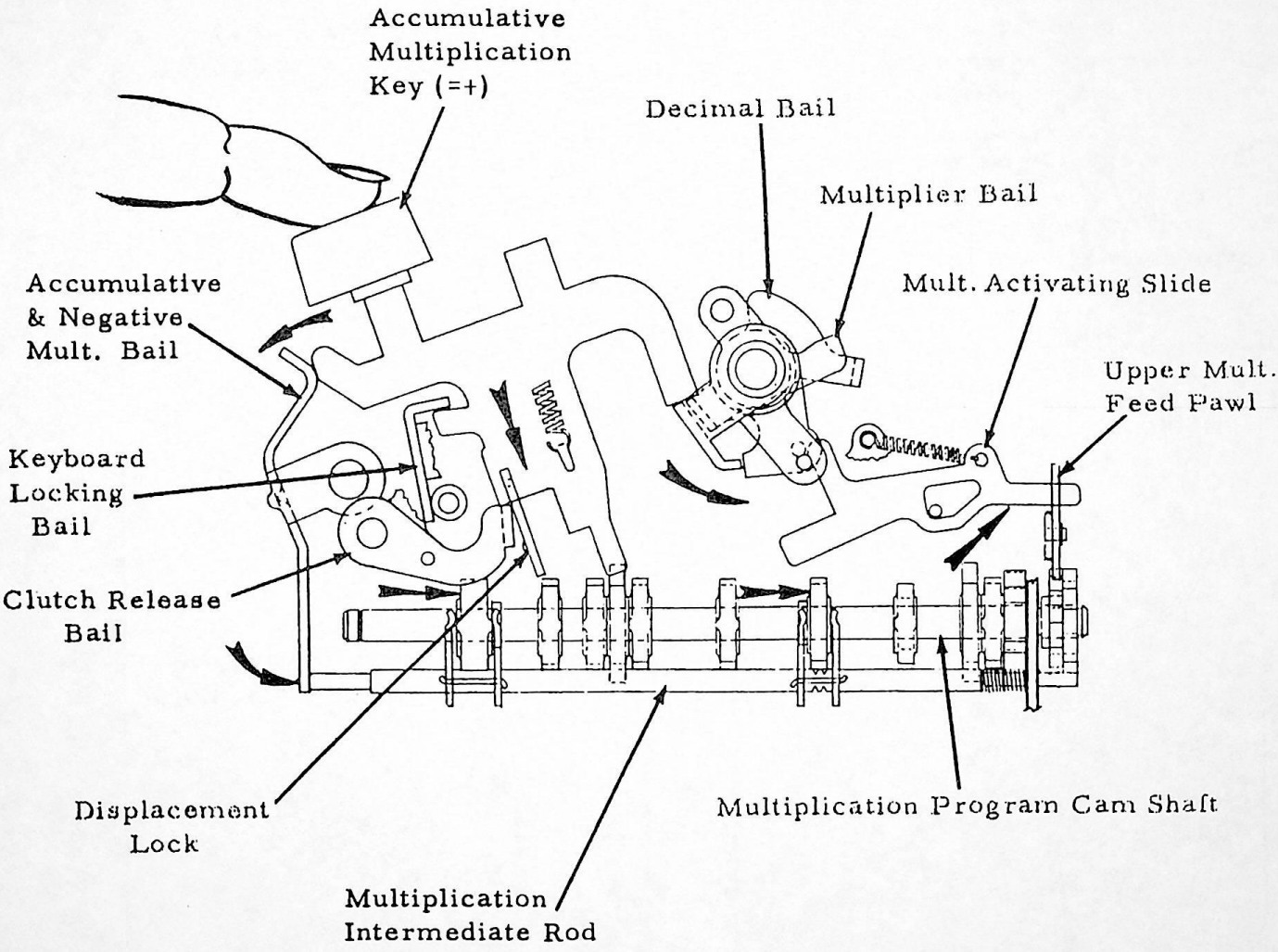


Safety Slide-Assem. & Operating Instr.





Release latch for Shift & Cycle Clutch Trip Control Slide will hold clutch release bail active if selector is 5 or more columns to left, so selector can shift fully home.


Accumulative Multiplication Key (=+)
Decimal Bail
Multiplier Bail
Mult. Activating Slide
Upper Mult. Feed Pawl
Accumulative & Negative Mult. Bail
Keyboard Locking Bail
Clutch Release Bail
Displacement Lock
Multiplication Intermediate Rod
Multiplication Program Cam Shaft

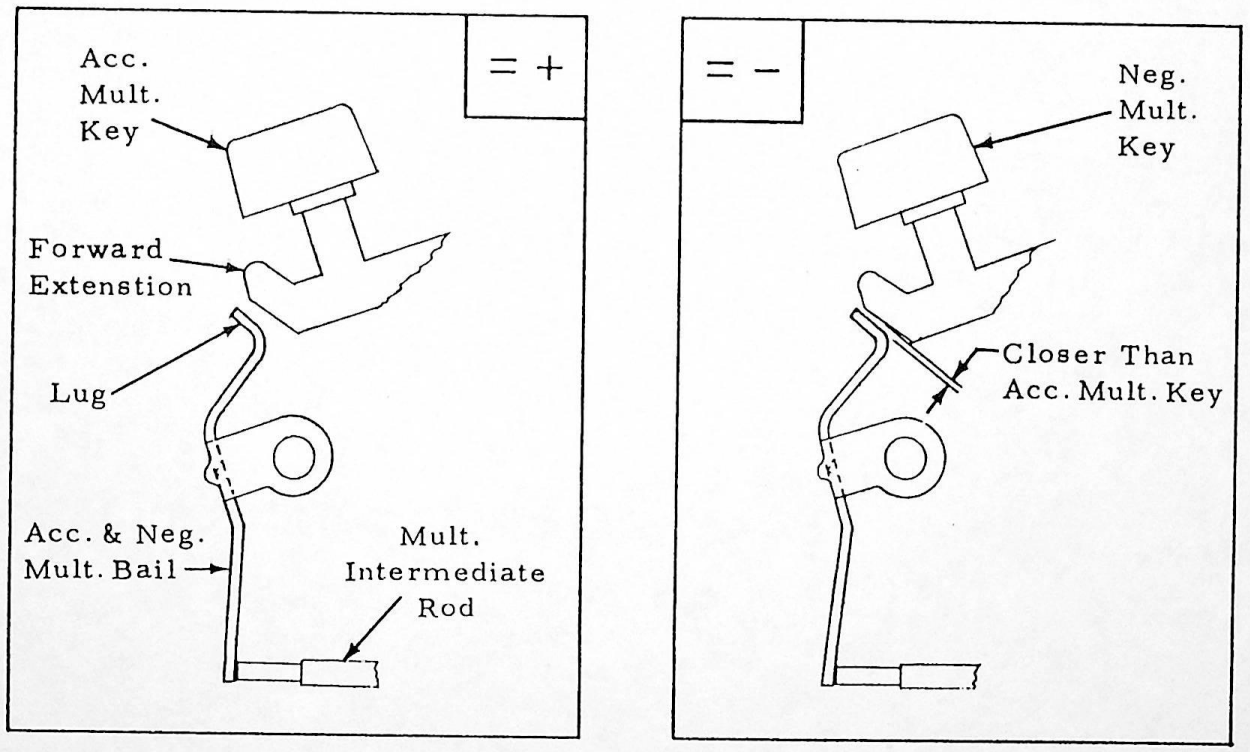
The accumulative multiplication operation is the same as the multiplication operation. . . with two exceptions:

1. The accumulative symbol (+) is printed to the right of the multiply symbol (=) on the first machine cycle.

2. The product is entered in the plus accumulator gears on the second half of the second machine cycle.

When the accumulative multiplication key is depresssed, it operates the same bails and locks as the multiplication key. . . . It also operates the accumulative and negative mult. bail.

A forward extension on the acc. mult. key contacts an upward projecting lug on the acc. and neg. mult. bail, pivoting the bail in a counter-clockwise direction. A downward projecting extension on the acc. and neg. mult. bail contacts the mult. intermediate rod and pushes the rod rearward.



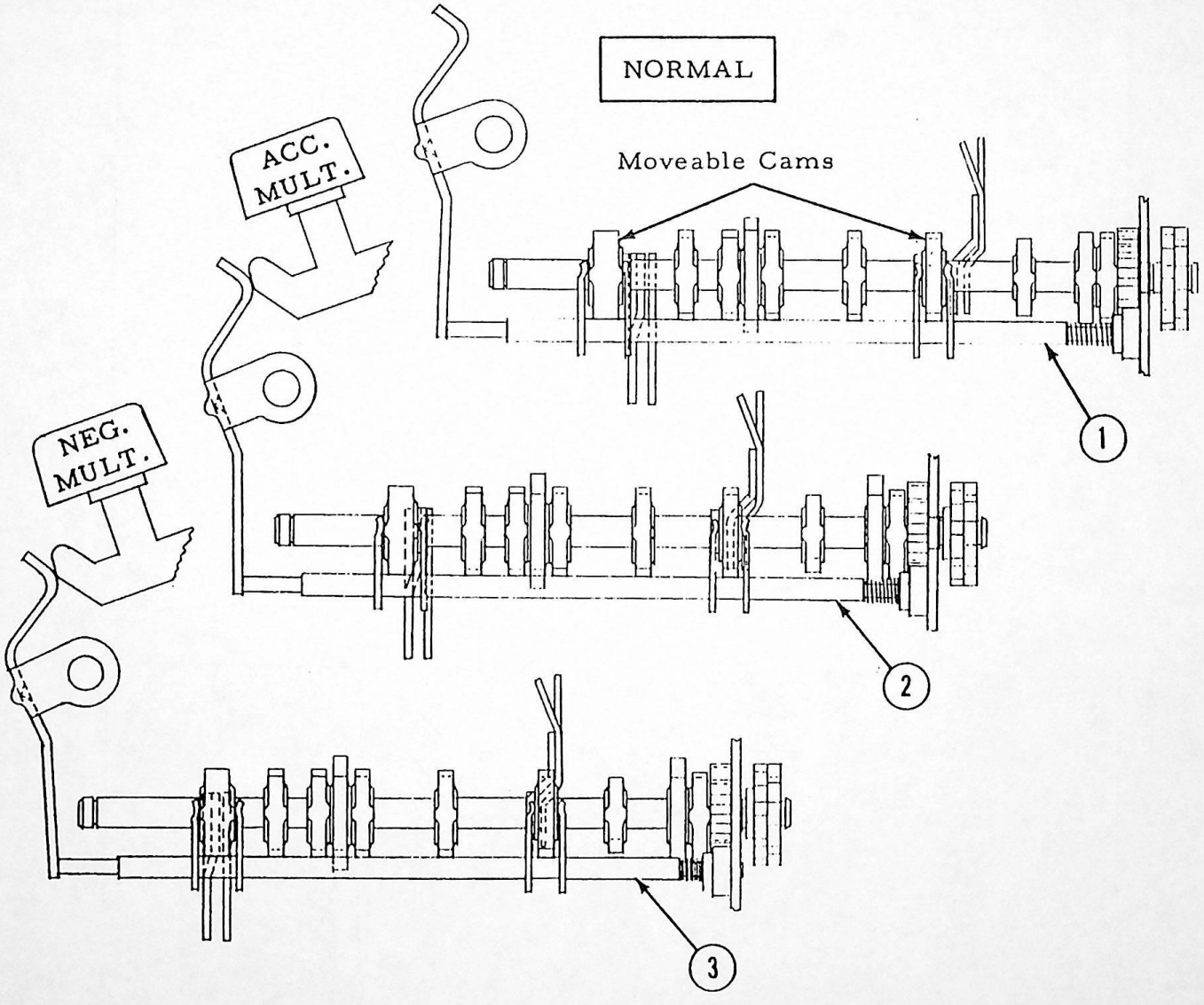
The negative mult. key also has a forward extension which operates the acc. and neg. mult. bail in the same manner. However, the upward projecting lug on the acc. and neg. mult. bail that is operated by the neg. mult. key is formed closer to the forward extension of the key. This causes the mult. intermediate rod to be pushed further rearward by the neg. mult. key than it is by the acc. mult. key.

We can therefore say that the mult. intermediate rod has three positions:

1. Full Forward.... This is the normal position in which the rod is held by its spring at all times except during acc. and neg. mult.

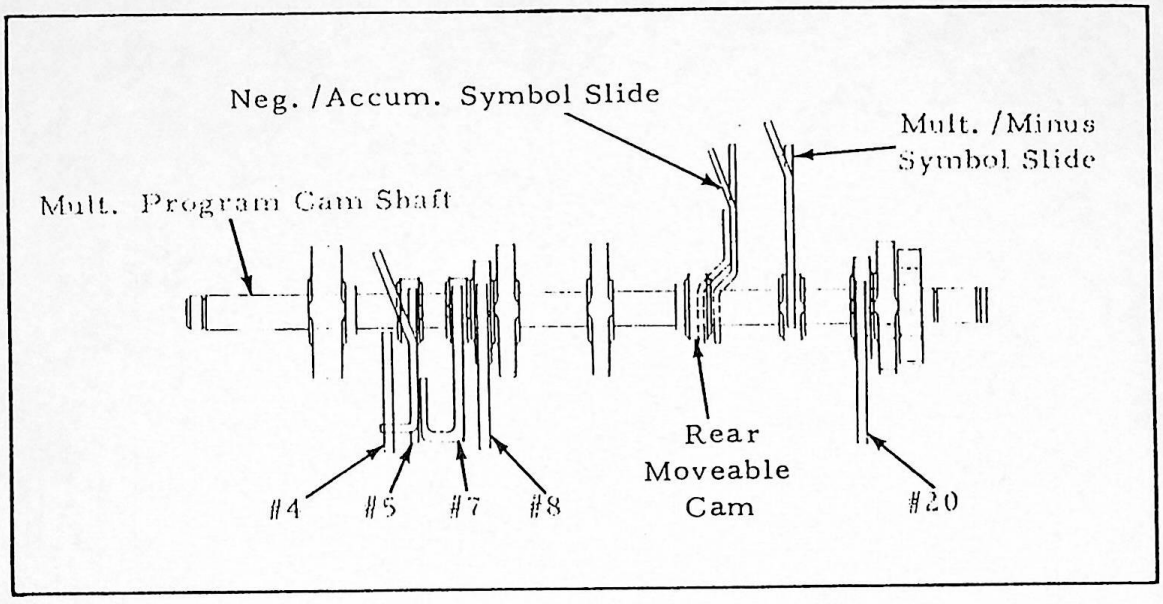
2. Half Rearward.... This is the position into which the rod is pushed by the acc. mult. key.

3. Full Rearward.... This is the position into which the rod is pushed by the neg. mult. key.

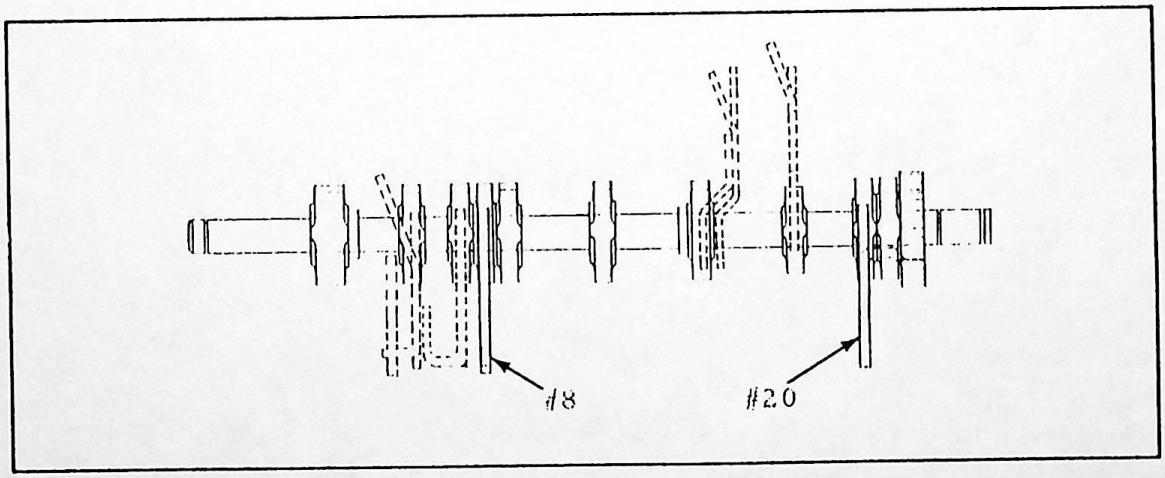


The mult. intermediate rod positions two moveable cams which are keyed to the multiplication program cam shaft. Neither of these two cams perform any function on a multiplication key operation with the intermediate rod in full forward position. ...They turn with the program cam shaft, but do not displace any slides.

When the mult. intermediate rod is pushed to its half rearward position, it aligns the rear moveable cam with the forward operating lug of the neg. /accum. symbol slide (9). . . . It also aligns the front moveable cam with the accumulator plus and minus program slide.

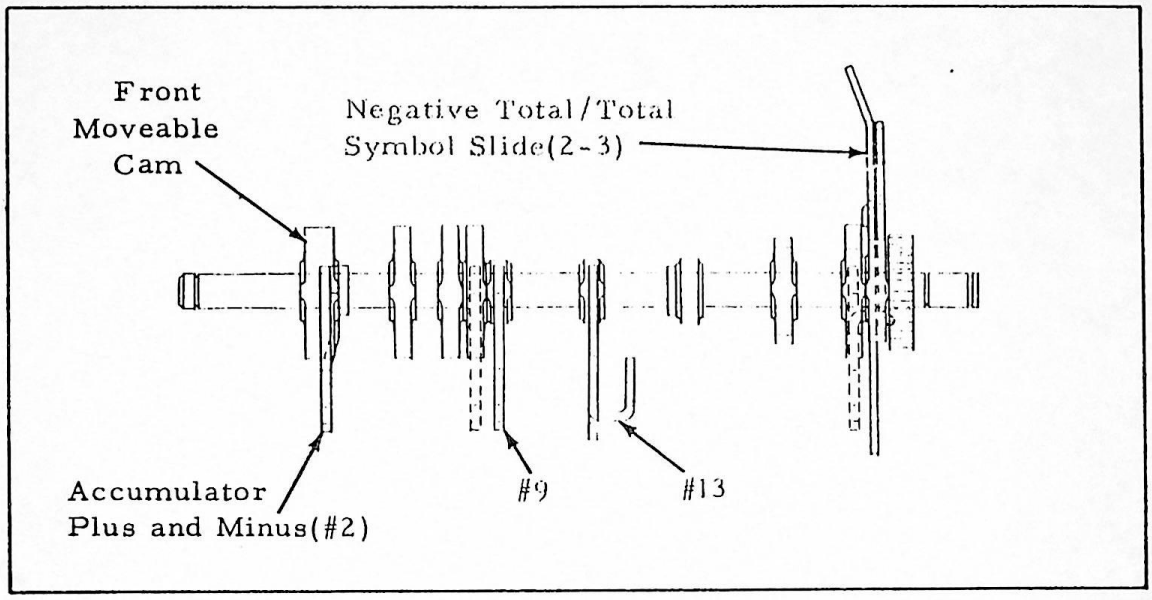


Therefore, when the mult. program cam shaft is indexed to its first active position at the start of the first machine cycle, the rear moveable cam will push the neg. / accum. symbol slide to its full right position. In this position the stop lug of the slide will contact the rearward step of the right symbol rack, as the racks move rearward to enter the multiplier. . . stopping the rack when it has positioned the accumulative symbol (+) on the right symbol wheel in alignment with the platen.



At the completion of the first machine cycle, as the program feed plate is returned to the right, the mult. program cam shaft is detented to its second position. The rear moveable cam releases the neg. /accum. symbol slide and the slide is returned to the left, to its normal position, by its spring.

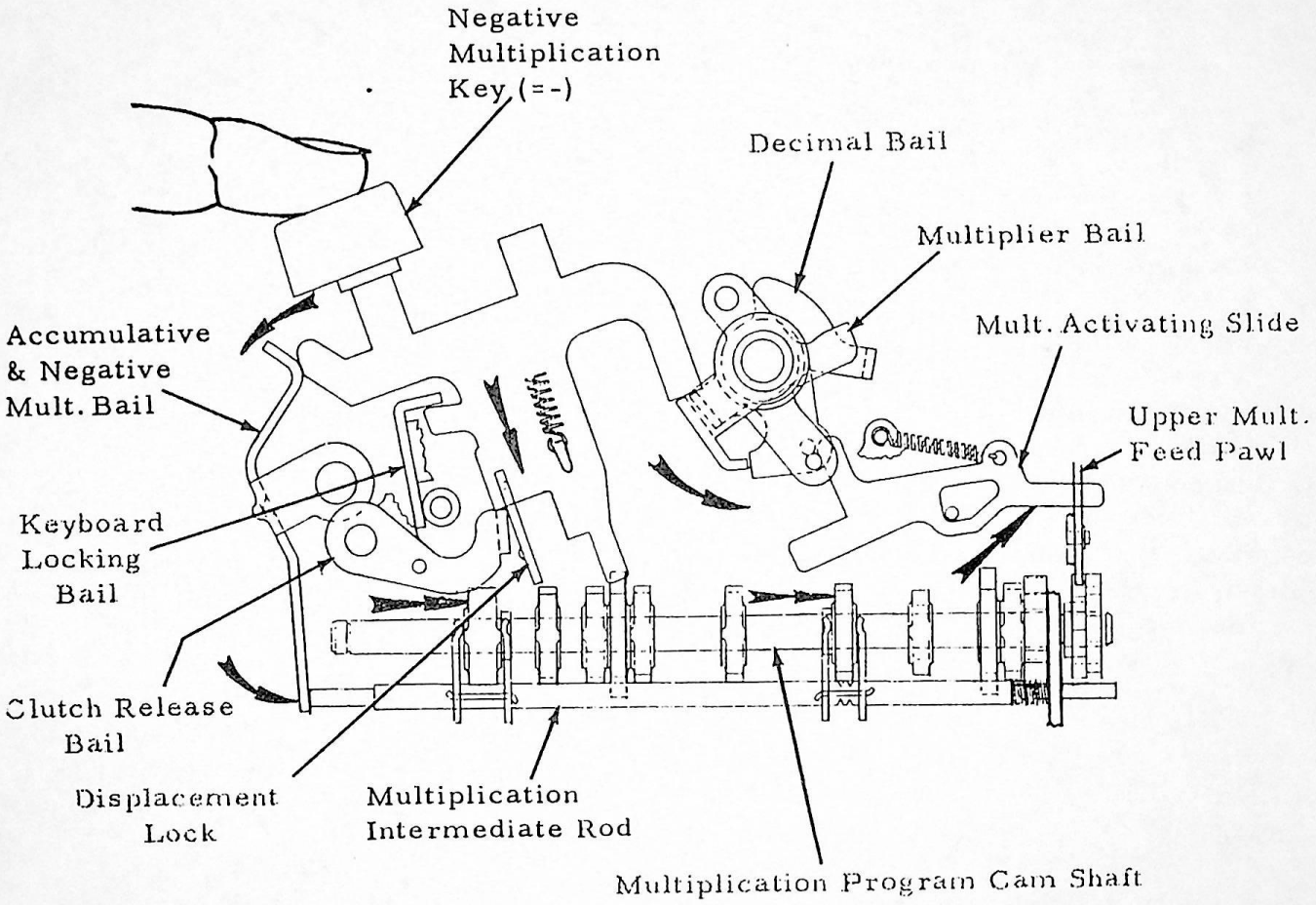
As the mult. program cam shaft is indexed to its third active position at the beginning of the second machine cycle, the front moveable cam pushes the accumulator plus and minus program slide (#2) to the left, which causes the plus and minus latch on the #3 operating slide to be raised into engagement with the accumulator engaging arm.



When this second (product) cycle is resumed upon completion of the high speed multiplication, the product will be entered in the plus accumulator gears in the same manner as an entry from a plus key operation. The racks, of course, will be controlled by the register instead of the set-up carriage. A detailed description of the function of the accumulator plus and minus program slide is provided on Pages IV-E-23 and 24.

When the mult. program cam shaft is detented to its normal position at the end of the product cycle, the front moveable cam releases the accumulator plus and minus program slide which is then restored to the right, to its normal position, by the spring on its program bell crank.

When the accumulative mult. key is released by the keyboard locking bail, its forward extension moves away from the upward projecting lug of the acc. and neg. mult. bail. The intermediate rod is then pushed forward by its spring to its full forward (normal position and the front end of the rod pivots the acc. and neg. mult. bail clockwise to its normal position.


Negative Multiplication Key (=-)
Decimal Bail
Multiplier Bail
Mult. Activating Slide
Upper Mult. Feed Pawl
Accumulative & Negative Mult. Bail
Keyboard Locking Bail
Clutch Release Bail
Displacement Lock
Multiplication Intermediate Rod
Multiplication Program Cam Shaft

The negative multiplication operation is also the same as the multiplication operation. . . with four exceptions:

1. The negative symbol (-) is printed to the right of the multiply symbol (=) on the first machine cycle.

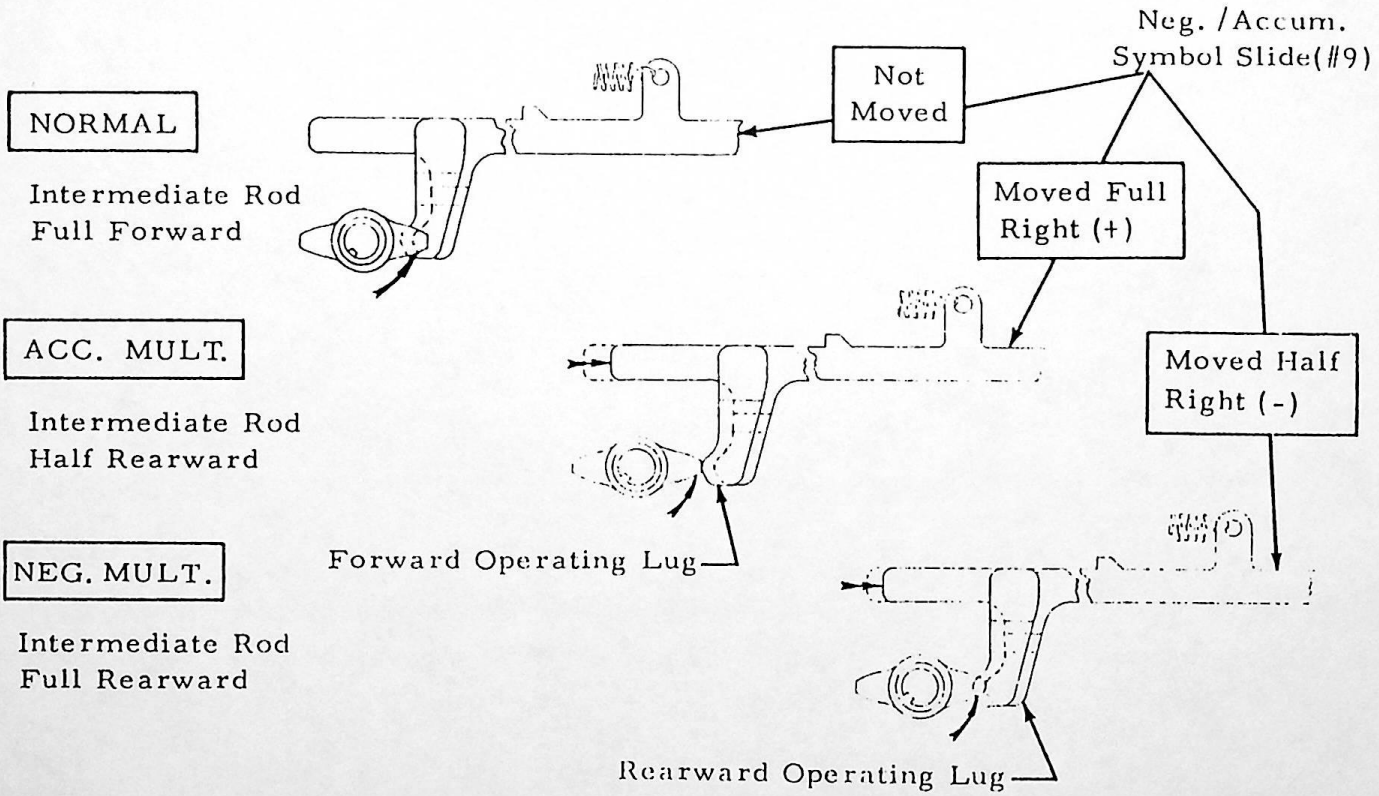
2. The product is entered in the minus accumulator gears on the second half of the second machine cycle.

3. The product is printed in red.

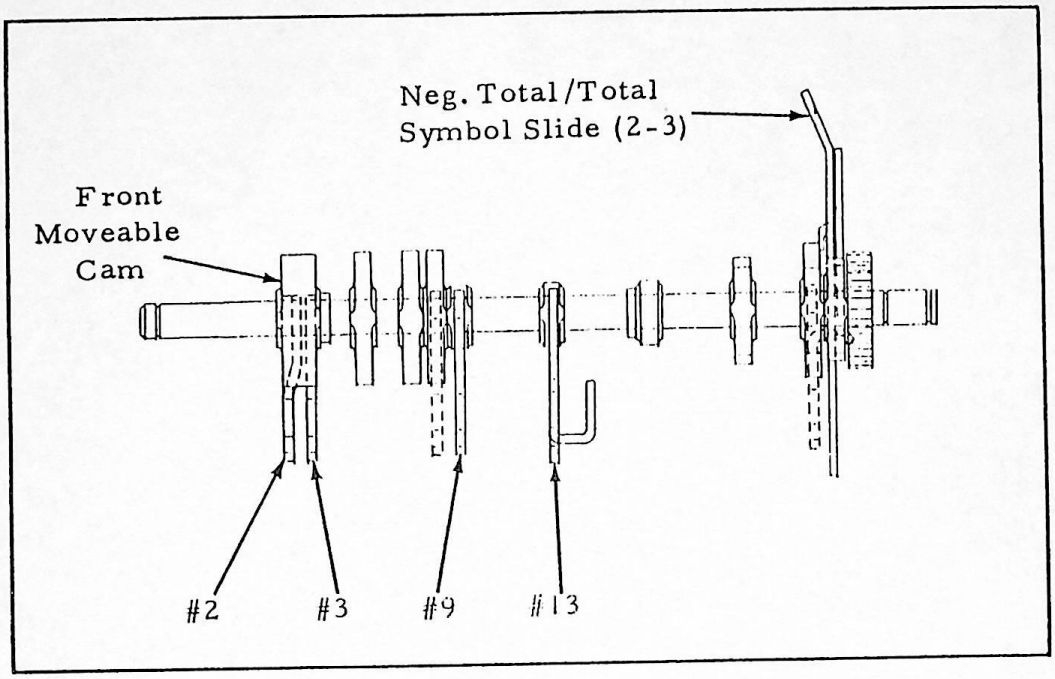
4. The negative total symbol (⁑) is printed, instead of the total symbol (*), with the product.

NOTE: Printing the product in red with the negative total symbol occurs automatically as a result of selecting the minus side of the accumulator.

On a negative mult. operation the mult. intermediate rod is pushed to its full rearward position, (See Page V-E-3). In this position the rear moveable cam is aligned with the rearward operating lug of the neg. /accum. symbol slide (9). This rearward operating lug is located further to the right on the slide than the forward operating lug. Therefore, when the mult. program cam shaft turns, the symbol slide will not be pushed as far to the right by the rear moveable cam as it was in acc. mult. The slide is pushed to its half right position where its stop lug will contact the forward step on the right symbol rack. . . stopping the rack when it has positioned the negative symbol (-) on the right symbol wheel in alignment with the platen.



The front moveable cam is a wide cam. With the intermediate rod in its full rearward position this front cam aligns with both the accumulator plus and minus program slide (#2) and the minus accumulator selection program slide (#3). Therefore, as the mult. program cam shaft is indexed to its third active position at the beginning of the second cycle, both the #2 and #3 program slides are pushed to the left.



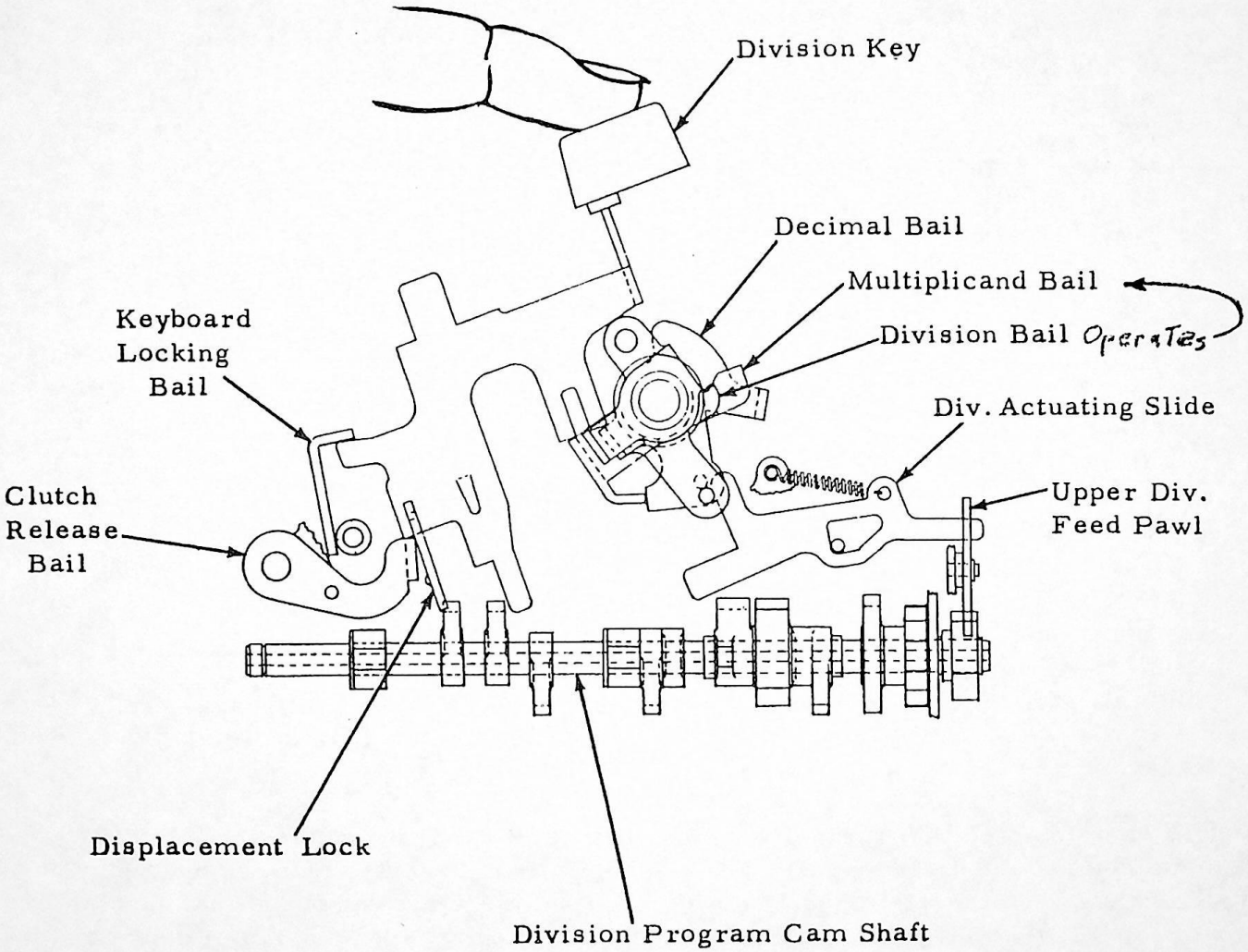
The minus accumulator selection program slide (#3), thru its bell crank, pulls the minus accumulator selection control slide forward. The minus accumulator selection control slide raises the minus control bail.

As the minus control bail pivots to its raised position, it raises the lug of the accumulator positioning latch into the path of the minus positioning link (see Page IV-E-18). Also, the left "leg" of the minus control bail pushes the red print/credit balance control slide forward. . . .

This forward movement of the red print/credit balance control slide pivots the color control arm (Page IV-D-19) and positions the forward lugs of the slide in "negative" blocking position in relation to the Negative Total/Total Symbol Slide (2-3) (Page IV-I-3).

NOTE: The Negative Total/Total symbol slide is activated on the product cycle of all multiplication operations.

Therefore, when the product cycle is resumed upon completion of the high speed multiplication, the accumulator will be rotated so that its minus gears are in rack engaging positions and the product will print in red with the negative total symbol (*). The accumulator will then be engaged as a result of having activated the accumulator plus and minus program slide (#2). . . and the product will be entered in the minus accumulator gears.


Division Key
Decimal Bail
Multiplicand Bail
Division Bail Operates
Keyboard Locking Bail
Div. Actuating Slide
Clutch Release Bail
Upper Div. Feed Pawl
Displacement Lock
Division Program Cam Shaft

The division operation is controlled by the Division Program Cam Shaft (See Page IV-B-2).

There are three possible variations in the division program. They are:

1. Normal Program.... With the Constant Divisor/Quotient Transfer lever in constant divisor position, an amount is entered in the set-up carriage and the division key depressed.

   Under these circumstances the selector will first be cleared, then the amount from the set-up carriage will be entered in the selector as the divisor.

2. Constant Divisor Program.... With the Constant Divisor/Quotient Transfer lever again in constant divisor position, no entry is made in the set-up carriage and the division key is depressed.

   Under these circumstances the selector will not be cleared and no entry will be made in it.... The last amount entered in the selector will remain and be used as the divisor.

3. Quotient Transfer Program.... With the Constant Divisor/Quotient Transfer lever in quotient transfer position, an amount is entered in the set-up carriage and the division key depressed.

   Under these circumstances the selector will be cleared and the amount from the set-up carriage entered in it... just as in the "normal program". However, on the quotient cycle, the selector will again be cleared and the quotient (from the multiplier/quotient gears) will be entered in the selector as the next multiplicand. NOTE: This quotient transfer selector entry could also be used as the next divisor if the constant Divisor/Quotient Transfer lever were restored to constant division position and no entry was made in the set-up carriage. However, such an application would result in the wrong decimal alignment of the quotient unless both decimal knobs had the same setting.

It should also be noted that if the division key is depressed without an entry in the set-up carriage and with the Constant Divisor/Quotient Transfer lever in quotient transfer position, the selector will be cleared... nothing entered... and the machine will perform a "zero division". This will occur because the lock which prevents a selector entry in constant divisor position when there is no set-up carriage entry is disabled in quotient transfer position.

The "Normal Program" will be covered first.

A division program requires three complete cycles of the main cam shaft.... On the first cycle the divisor is removed from the set-up carriage, the selector cleared, the divisor printed and then entered in the selector. On the second cycle the main cam shaft is stopped at the hold-up position (30°) while the high speed mechanism performs the actual division. When the division is completed, the main cam shaft

Division Cam Shaft and Program Slides

Step I
First machine cycle and at 30° hold-up.
Division cam shaft at 60°.

#5 Set-up carriage escapement (and drives #4).
#4 Set-up carriage engagement (and locks decimal and numeral keys).
#7 Set-up carriage return (and moves the decimal bail to the right).
#17 Enter divisor (and selects the middle decimal selecting bar).
#20 Repeat.
#10 Divide/Remainder symbol slide 1/2 right, and controls left symbol rack to print (÷).
#7 Multiplicand symbol slide full right, and controls right symbol rack to print (X).

Step II
End of first machine cycle 321° to 355°.
Division cam shaft at 120°.
All previous program and symbol slides restore except the following.

#15 Division and transfer trip (moves to the right).
#20 Repeat.

Step III
Secomd machine cycle and at 30° hold-up.
Division cam shaft at 180°.
#15 slide restores.

#13 Shift/Cycle clutch trip.
#1 Quotient total (selects the lower decimal selecting bar).
#20 Repeat.
#2 & #3 Neg total/Total symbol slide goes full right, and controls the left symbol rack to print (*).

Step IV
End of secomd machine cycle 321° to 355°.
Division cam shaft at 240°.
All previous slides restore except #20 Repeat.

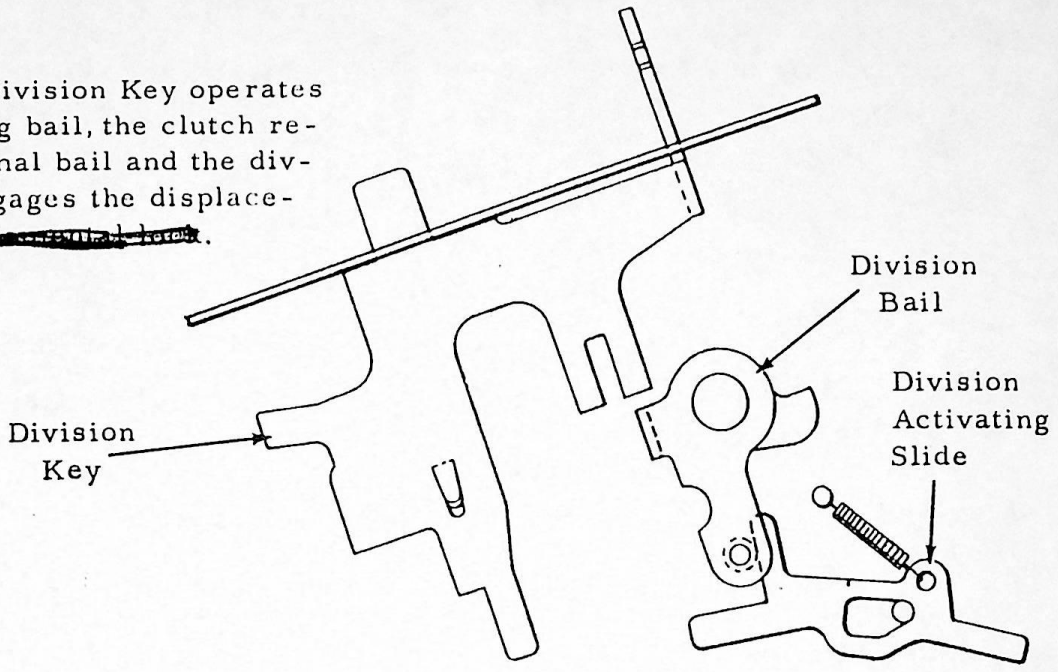
Step V
Third machine cycle and at 30° hold-up.
Division cam shaft at 300°.

#9 Register total (upper decimal selecting bar selected).
#14 Hold-up latch disabling.
#10 Divide/Remainder symbol slide full right, and controls left symbol rack to print (R).

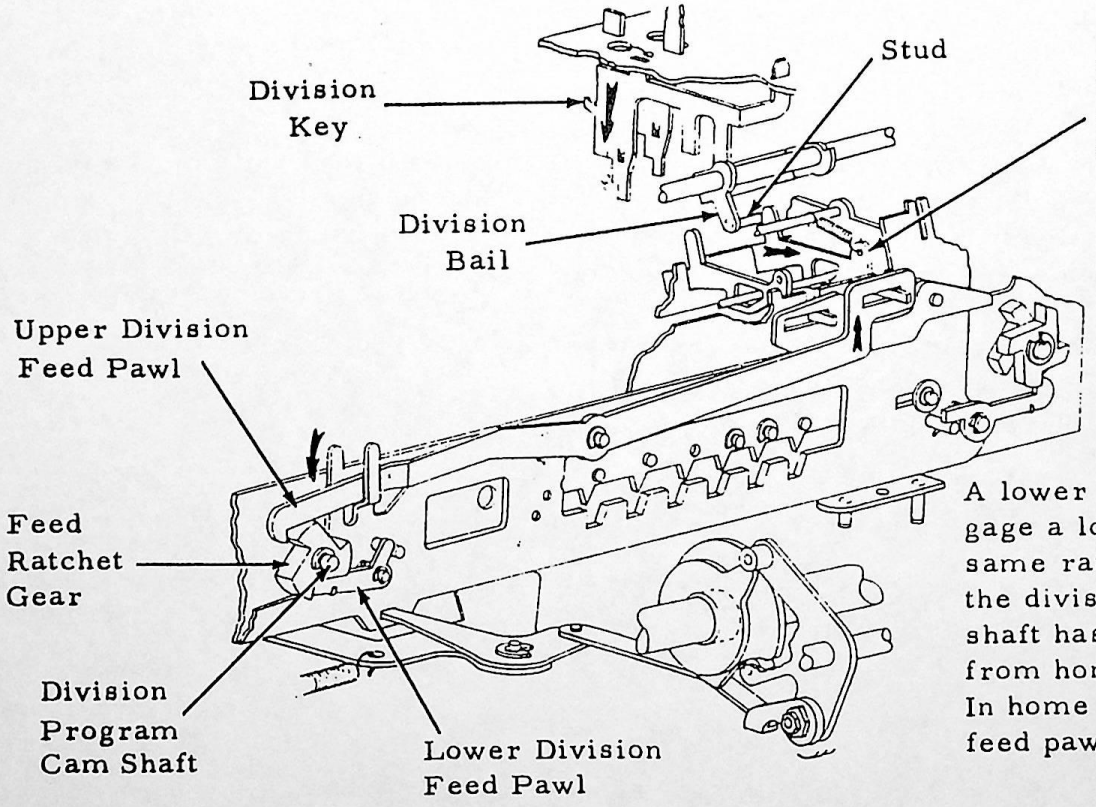
Step VI
Cam shaft turned to neutral and the end of the third cycle and all slides restore.

cycle is resumed. The quotient is removed from the multiplier/quotient gears and printed. On the third cycle the remainder is removed from the register and printed.

Depression of the Division Key operates the keyboard locking bail, the clutch release bail, the decimal bail and the division bail. . . and engages the displacement lock and [illegible].



As the division bail pivots, a stud on its lower right end extension pushes the division activating slide up and to the rear. The rear extension of the division activating slide, engaged in a slot of the upper division feed pawl, pivots the operating tip of the pawl down into alignment with the feed ratchet gear on the rear end of the division program cam shaft.



A lower feed pawl will engage a lower tooth of the same ratchet gear, once the division program cam shaft has been displaced from home position. . . Note: In home position, the lower feed pawl is inoperative.

As the main cam shaft cycles, the program feed plate is driven to the left. The upper division feed pawl indexes the division program cam shaft to its first active detent position. As the shaft is indexed, its program cams activate the following program slides:

Set-up Carriage Escapement (#5) which activates the Set-Up Carriage Engagement (#4)

Set-Up Carriage Return (#7)

Enter Selector (#17)

Repeat (#20)

Another cam pushes the divide/remainder symbol slide (10) to its half right position where, when the racks move rearward, its stop lug will contact the forward step of the left symbol rack... stopping the rack when it has positioned the divide (÷) symbol on the symbol wheel in alignment with the platen.

On this "Normal Program", still another cam pushes the multiplicand symbol slide (7) to its full right position. It will stop the rearward step of the right symbol rack for printing the multiplicand (×) symbol. This symbol is used to indicate that the divisor will remain as a constant.

Note that the program slides activated are the same as those activated on the Enter Multiplicand cycle by the enter multiplicand program bail... except for the repeat slide (#20). Since the repeat slide is operated on multiple cycle programs to permit the main cam shaft to cycle thru its "home" position without stopping, it is not required on the single cycle Enter Multiplicand program.

Because this first cycle of the division program and the enter multiplicand program are almost identical, the functional description in the "Enter Multiplicand" section will be used for both... see Page V-B-1.

Near the end of the first cycle of main cam shaft, the program feed plate moves to the right and the lower feed pawl engages the ratchet gear of the division program cam shaft, moving it to its second active detent position. In this position, the following program slides are released and restore to normal.

Set-up carriage escapement (#5)
Set-up carriage engagement (#4)
Set-up carriage return (#7)
Enter selector (#17)

The divide/remainder (10) and multiplicand (7) symbol slides are also released and restore to normal.

The repeat (#20) program slide remains activated.

The division and transfer tabulating program slide (#15) is moved to the right by a cam on the division program cam shaft on this return movement of the program feed plate...Note:This is the only program slide that is moved to the right of normal position. It is also moved to the left of normal on transfer key functions.

Division and Transfer Tabulating Program Slide (#15)
(Division Function)

Movement of the division and transfer program slide (#15) to the right pivots a bell crank which pulls a link forward. This link is attached to the lower end of a lever which is mounted on the inside of the left side frame...The tab. trip link is attached to the upper end of this lever and it is moved rearward as the lower end of the lever is pulled forward.

A downward extending lug near the rear of the tab trip link engages a stud on an upstanding crank arm, attached to the left end of the tab trip shaft and rocks the shaft clockwise.

The middle arm on the tab trip shaft has a forward extending nose which rests under a stud attached to the division control arm... to the rear of its pivoting point. The division control arm is spring held clockwise. As the tab trip shaft rocked clockwise, the middle arm rocked with it...rocking the division control arm counter-clockwise. The division control arm displaces the following related parts.

1. The forward nose of the division control arm cams a single toothed disc to the right...aligning the tooth with the 4th cam on the division sequence cam shaft. (This disc is spring held to the left...is slideable and is splined to a shaft driven by and coupled to the shift clutch).

2. The rear part of the stud on the division control arm moves the hold-up link rearward blocking the hold-up latch so that the main cam shaft clutch cannot be released until high speed division is completed. The forward pivotal extension of the trip arm on the hold-up link drops behind the forward lug of the hold-up latch extension.

3. A lug on the rearward extension of the division control arm moves up out of the path of a clamp arm on the left end of the division shift/cycle clutch shaft. This releases the shift clutch for the first shift cycle. (More about this later).

4. The lower extension of the division control arm positions to the rear of the shift slide...which will

move to the left (to block the restoring of the division control arm) on the first shift cycle.

The right end of the tab trip shaft has a crank arm with a stud engaged in a fork of a crank arm near the left end of the tab shaft ...Therefore, at the same time the tab trip shaft was rocked clockwise, the tab shaft was rocked counter-clockwise...rocking a slideable tabulating "shoe" which is splined to the tab shaft and spring held to the right. The tip of the tabulating "shoe" is now forward of the outer diameter of a disc mounted on the tab stop shaft which is located forward of the tab shaft.

A locating arm on the right end of the tab. shaft is also rocked counter-clockwise...and a positioning pin attached to the forward extension on the left end of a bail moves from the middle high dwell of the locating arm down into the lower locating dwell (rear part of locating arm). The front of the bail rocks down and a rear extension on the right end of the bail moves up...raising a control slide into controlling position with respect to a number of devices as follows. Note: The control slide and bail are moved by a spring on the slide and the positioning pin on the bail holds the tab. shaft and tab. trip shaft in active position.

The lower left facing step on the control slide blocks the lower extension of the fish tail, preventing the fish tail from pivoting when the selector carriage is shifted out of the first position.

A diamond shaped stud on the forward extension of the control slide moves upward and will later engage the upper extensions of the scissors latches.

An upper lug on the control slide moves behind a step of the shift/cycle clutch release link preventing it from moving rearward temporarily when the division sequence shaft is detented one position during the initial shift cycle. More about this later....

As the blocking lug on the rear extension of the division control arm was raised, the spring urged push/pull link pulls the clamp arm on the left end of the shift/cycle shaft clockwise, until the roller on the cam follower on the forward end of the push/pull link limits against the 2nd cam of the division sequence cam shaft.

Movement of the clamp arm on the left end of the shift/cycle shaft pivots the shift/cycle shaft clockwise and a downward extending crank arm on the right end of the shaft moves forward. The shift/cycle clutch release link...attached to the right crank arm is moved forward, and the nose on the upper forward extension of the shift/cycle clutch release link engages a stud on the shift clutch latch moving the latch out of engagement with the shift clutch pawl, the shift clutch pawl engages the clutch drive gear and the shift clutch rotates. (The toothed drive belt on the control unit is driven by the high speed shaft...See page II-B-1).

During the first half rotation of the shift clutch, the fish tail is driven by a link whose forward end fits over an eccentric hub on the shift clutch, the rear of the link is attached to an arm which moves the fish tail and shift feed pawls simultaneously first to the rear, during the first half of the shift cycle and then forward during the second half of the shift cycle. During the first half of the shift cycle, the fish tail's upper camming surface engages the upper lug on the shift feed pawl positioning plate raising it up...where it will be held by a toggle spring. The upper feed pawl is disengaged from the right shift ratchet gear on the selector carriage worm shaft, and the lower feed pawl engages the left shift ratchet gear. This happens as the feed pawls move rearward with the fish tail. Also, a collar on the shift drum disengages the shift/cycle release link from the stud on the shift clutch latch.

All of the above occurred as a result of moving the division and transfer tabulating program slide to the right on the return program feed movement of the first main shaft cycle...and, while these things were happening, the main shaft continued into its second cycle without interruption (since the repeat program slide (#20) was active.... See page V-D-15).

The main shaft rotates to hold-up position (30°) in the second cycle, where it is stopped by the hold-up latch.

During this main shaft rotation, the program feed plate is driven to the left again and the upper division feed pawl displaces the division program cam shaft to its third active detent position.

This restores the division and transfer tab (#15) program slide to normal.

The repeat program slide (#20) remains active....

And, the following program slides are activated:

Quotient total (#1)
Shift and cycle clutch trip (#13)

The negative total/total symbol slide (2-3) is also moved to its full right position where its stop lug will be positioned to contact the rear lug on the left symbol rack for printing the total (*) symbol. Note: This total symbol is used to indicate "quotient" on division operations.

Quotient Total Program Slide (#1)

Movement of the quotient total program slide (#1) to the left pivots a bell crank which pulls the quotient total control slide forward. The forward movement of the quotient total control slide does two things....It pivots the positioning bail for the lower decimal selecting bar and raises the quotient total control bail.

The pivoting of the positioning bail for the lower decimal selecting bar is accomplished by a lug on the quotient total control slide. This function is exactly the same as that performed by the lug on the enter multiplier control slide.(See pages V-D-14 and 15).

The raising of the quotient total control bail raises the quotient total latch (rear latch) on the #2 operating slide into alignment with the positioning segment for the multiplier/quotient gear assembly.

The function of the shift and cycle clutch trip program slide (#13) has been described in the multiplication key section (page V-D-29). In division however, none of the three sensing bails employed during multiplication are activated...so the clutch selecting cam would always be aligned with the roller of the shift clutch latch. The shift clutch therefore...having been tripped by the shift/cycle clutch release link (which was immediately disabled as the clutch started to rotate) will remain tripped thru the action of program slide #13.

As the clutch release lever was pivoted thru the action of program slide #13, its lower lug moved out of the gap between the scissors latches and the flat latch pivoted into position above the lug.

During the second half cycle of the shift drum, the fish tail and shift feed pawls move forward. The lower shift feed pawl which is engaged with the left shift ratchet gear on the selector carriage worm shift shaft moves the ratchet gear one tooth space shifting the selector carriage one column to the left.

During the left movement of the selector carriage from the first to the second column, the shift slide, by spring tension, also moves to the left. The rearward extending lug near the right end of the shift slide moves away from the fish tail....However, the lower step of the raised control slide blocks the fish tail...preventing it from pivoting to where it would cam the positioning plate down. Therefore, the feed pawl positioning plate stays up and the feed pawl will remain positioned to shift the selector carriage to the left.

The forward extending camming lug on the shift slide moves away from the upstanding arm on the left extension of the bail latch of the scissors. The scissors latches rock clockwise...and the upper extension of the bail latch contacts the diamond shaped stud on the raised control slide.

The left end of the shift slide moves into the path of the lower extension of the division control arm. (This will prevent the division control arm from restoring when the tab. shaft and tab. trip shaft are reset later by the selector carriage shifting into the tenth column).

Near the end of this first shift clutch rotation, the roller on the eccentric stud on the end of the shift clutch shaft releases the star gear locators and engages the top of the vertical disabling link. Downward movement of the vertical disabling link disengages the trip latch from the clutch starting bail...and the clutch release lever moves toward the scissors where it is blocked by the bail latch of the scissors....The clutch selecting cam therefore, will hold the shift clutch latch released...and the shift clutch will continue to rotate, shifting the selector carriage to the left.

Also, near the end of the first shift clutch rotation, the single tooth on the disc driven by the shift clutch shaft contacts a lobe on the 4th cam of the division sequence cam shaft...detenting the cam shaft one position. This occurs about the time the shift clutch completes its first cycle and the selector carriage has moved to the 2nd column.

When the division sequence cam shaft is detented one position, the lobe on the second cam rocks its cam follower and the attached push/pull link rearward...rocking the shift/cycle shaft counter-clockwise. The right crank arm starts to move the shift/cycle clutch release link rearward...the nose on the upper forward extension starts to move out from under the stud and the upstanding hook on the lower forward extension of the shift/cycle operating link starts to move toward the roller of the cycle clutch latch. The shift/cycle clutch release link however, is blocked by the upper lug on the control slide before the hook contacts the cycle clutch latch.... This stops the shift/cycle shaft from pivoting. However, the push/pull link moves rearward and its slot moves rearward on the stud of the clamp arm....A spring coupling the push/pull link to the stud of the clamp arm is thereby loaded....Later, this loaded spring will rock the left clamp arm, shift/cycle shaft, right crank arm and shift/cycle clutch release link rearward (counter-clockwise) when the control slide moves down releasing the shift/cycle clutch release link. The upward extending nose will then release the cycle clutch. More about this later...

Other cams were activated as the division sequence cam shaft moved one position. We will cover them later.

Since the bail latch of the scissors is holding the clutch release lever, the shift clutch continues to rotate, shifting the selector carriage to the left until a forwardly extending plate on the selector carriage contacts the right side of a tabulating "shoe" on the tab. shaft....As the selector carriage moves from the 9th column to the 10th, the left camming edge of the slideable tabulating "shoe" is driven against the disc on the tab. stop shaft, causing the tabulating "shoe" to rock rearward. Since the tabulating "shoe" is splined to the tab. shaft, the "shoe" and shaft are rocked clockwise...the coupled tab. trip shaft is rocked counter-clockwise and the locating arm on the right end of the tab. shaft cams the pin on the control slide bail up into the top locating dwell. This motion lowers the control slide at the rear of the bail.

As the control slide moves down, the diamond shaped stud contacts the upper camming extension of the bail latch of the scissors. The scissors try to move as a unit, but the flat latch of the scissors is blocked by the lower lug of the clutch release lever, so only the bail latch moves rearward....Therefore, an opening occurs between the scissors latches into which the clutch release lever moves....This releases the shift clutch latch which blocks the shift clutch pawl, stopping the shift clutch from rotating. A rebound latch drops into a step on the shift clutch hub. This holds the clutch in neutral position wo that it will not "chatter".

At the same time, the upper lug on the control slide releases the shift/cycle clutch release link and, as it moves as it moves rearward, it trips the cycle clutch to rotate the selector and carry shaft for division calculation. (Remember, the push/pull link spring was loaded by the second cam when the division sequence cam shaft was detented one position).

The lower step of the control slide moves away from the lower camming extension of the fish tail, and the fish tail pivots under spring tension. Now its lower camming surface will engage the lower lug of the shift feed pawl positioning plate to drive the positioning plate down for right shift of the selector carriage during automatic division, when required.

Also, when the tab. trip shaft restored, the nose of its middle arm moved away from its holding position on the stud of the div. control arm....The div. control arm is still held active however, since the left end of the shift slide positioned in front of its lower extension....Therefore, the div. control arm holds the single toothed disc and hold-up link active and its rear lug is out of the path of the shift/cycle shaft clamp arm. As a result, the machine will continue to divide until the selector carriage returns to the 1st column where the high speed mechanism is stopped. This will be described later.

We will now examine the relative position of the cams on the division sequence cam shaft with respect to their related cam followers and rotating feed fingers. Remember, the division sequence cam shaft was detented one position by the single tooth disc on the shift clutch shaft, at the end of the first shift cycle...and it stayed in this position while the selector carriage was being shifted to the left.

Division Sequence Cam Shaft (First Detented Position)
(Cams are identified numerically counting from right to left).

1st cam lobe engaged the roller on its rocker arm follower...rocking it clockwise. The lower extension of the rocker arm engages a roller

on the crank arm on the left end of the plus/minus slot cam shaft... rocking the shaft and its two slot cams counter-clockwise. The left slot cam shifts the M/Q counting ratchet gears to the right, aligning the left M/Q counting ratchet gear with the upper counting pawl for additive count of the M/Q gear....The right cam moves the positioning plate on the selector carriage to the right so that the selector is in "minus" alignment with the register intermediate gears (See page V-B-26).

2nd cam lobe, as previously described, rocks its cam follower and push/pull link rearward, the shift/cycle clutch release link moved rearward slightly where it was blocked by the raised control slide. The continued rearward movement of the cam follower and push/pull link loaded the spring which fired the shift/cycle clutch release link rearward at the end of the left shift operation of the selector...tripping the cycle clutch.

As the division sequence cam shaft is rotated into this first detent position on subsequent division operations, this high lobe on the 2nd cam will cause the shift/cycle release link to trip the cycle clutch immediately...since the upper extension of the control slide does not block the shift/cycle clutch release link during the remainder of division calculation.

3rd cam lobe is inactive.

4th cam lobe is inactive.

5th cam is inactive.

6th cam lobe moved away from the roller on the rear extension of the division trip cam holding pawl...lowering the pawl into engagement with the ratchet teeth of the "division trip cam." This holding pawl has two forward extensions, the right extension engages a lug on the hold-up link. The left extension is the holding pawl for the "division trip cam" ratchet teeth. A feed pawl which sets slightly behind the holding pawl has an angular lug which rests over the holding pawl. The feed pawl also moves into engagement with the ratchet teeth when the holding pawl is lowered....The rear of the feed pawl is connected to an eccentric stud on the left end of the carry drive shaft and, during each rotation of the cycle clutch, the feed pawl moves forward, then rearward. On the forward movement of the feed pawl, the division trip cam is fed one tooth with enough excess for the holding pawl to drop safely into the preceding tooth, the holding pawl prevents the cam from being pulled back clockwise by its spring as the feed pawl is motioned rearward by the carry drive shaft.

Note: Each time the division sequence cam shaft is fed to home position, the holding pawl is raised by the 6th cam lobe contacting the roller on its rear extension....The trip cam is then spring driven to restored position. This operation will be repeated until the division calculation is completed. More about this later.

Now back to the cycle clutch....The selector is cycled in its "minus" position....The carry shaft rotates in unison with it.

With the selector in its "minus" position, it is subtracting the divisor from the dividend in the register gears, by adding the complement of the divisor to the register gears.

For each rotation of the cycle clutch, with the selector in "minus" position the M/Q gear aligned with the first column of the selector is displaced one tooth in an additive direction (clockwise).

NOTE: We have stated that with the selector in "minus" position the M/Q gear is counted in an"additive" direction....By this we mean the M/Q gear is turned from 0 to 1...from 1 to 2...from 2 to 3...etc. When the selector is in "plus" position, the M/Q gear is counted in a "subtractive" direction....That is, from 3 to 2... or from 2 to 1...or from 1 to 0 etc.

The M/Q gears will contain the quotient at the end of the division calculation. The quotient is arrived at by counting the number of times in each column, the divisor can be subtracted from the dividend (starting with the first column of the divisor aligned with the tenth column of the dividend) before the divisor exceeds the dividend. This number of times the divisor is subtracted form the dividend (minus selector cycles) is counted into the aligned M/Q gear by the upper counting pawl.

Since the machine will cycle and count until it receives a signal that the divisor exceeds the dividend (This "signal" is a "9" in the 21st column register gear)...and we are interested in the number of cycles that occur before the divisor exceeds the dividend... the "true" divisor must be added back into the dividend and one count removed from the aligned M/Q gear to give us the proper quotient count. This cycle in which the divisor is added back into the dividend is known as the "correction stroke".

The M/Q counting shaft has a slideable gear keyed to it. This gear is engaged with a gear train which meshes with the M/Q gear, therefore, when the M/Q counting shaft turns one tooth, it also turns the M/Q gear one tooth. The M/Q gear counting train is held in a cage which is a rearward extension on the selector carriage....As the selector carriage shifts one column at a time to the right, it moves the gear train also, resulting in a relationship of counting the M/Q gear with respect to the column in which the selector is calculating, since the gear train is aligned with the 1st selector column.

This counting mechanism is illustrated and described on pages V-D-44 and 45 in the Multiplication Key section.

This subtract calculation (adding complements) will continue until a 9 is held in the 21st gear (after carry takes place). Bear in mind that a tens carry from the 20th column can change the 9 to

zero...or a tens carry from the 20th column can change an 8 in the 21st gear to a nine.

As the 21st gear is moved to 9, a trip pin which engages the periphery cam of the gear (0 to 8) drops into a dwell in the 21st gear cam....The rearward end of the trip pin lever is under a rocker arm whose upward extension pivots to the right, permitting a shiftable spring driven feed finger to move to the right in alignment with the lobe of the 3rd cam, displacing the division sequence cam shaft to the next position...before the next cycle.

Note: If a 9 in the 21st gear is moved to zero due to a carry, the trip pin and feed finger move into and out of active position before the feed finger contacts the lobe on the 3rd cam....Note: Any figure from 0 to 8 in the 21st register gear holds the trip pin, related pivotal levers, and feed finger in inactive position and the feed finger misses the lobe on the 3rd cam.

Division Sequence Cam Shaft (Second Detent Position)

Correction Stroke

When the division sequence cam shaft moves into its second detented position, as result of a trip in the 21st register gear...(fed by slideable feed tooth contacting lobe of the 3rd cam) the roller on the rocker arm follower moves into the low part of 1st cam...the lower extension of the rocker arm moves rearward...and the crank arm on the left end of the plus/minus slot cam shaft follows under spring tension....The left slot cam shifts the M/Q ratchet gears to the left...aligning the right counting ratchet gear with the lower counting finger for subtractive rotation of the M/Q gear... subtracting one from the M/Q gear during the plus correction stroke (addition of true figure).

2nd cam...roller on the cam follower moves to the intermediate part of the 2nd cam...push/pull link moves partially forward rocking the shift cycle shaft...the crank arm on the right end of the shaft moves the shift/cycle clutch release link forward...until the nose on the upper extension just contacts the square stud on the shift clutch latch...shift clutch stays inoperative....The hook on the lower extension of the shift/cycle clutch release link moves forward and the cycle clutch latch moves toward the cycle clutch, by this time the cycle clutch pawl has passed the clutch latch....The cycle clutch will make the correction stroke....This partial movement insures relatching of the cycle clutch after one rotation of cycle clutch (correction stroke). The 9 in the 21st register gear is turned to zero by the carry-over into this gear.

3rd cam is inoperative.

4th cam is inoperative.

5th cam lobe will be engaged by the fixed feed finger on the carry drive shaft at the end of the correction stroke feeding the division sequence cam shaft to home position where shift operation occurs.

6th cam lobe is inactive....So division trip cam feed finger moves division trip cam one tooth during correction stroke.

Division Sequence Cam Shaft (Third Detent Position)

Note: The division sequence cam shaft has been detented a total of 180°. Since the cams on this shaft are "double cams" (the same contour on both sides of a centerline thru "home" position) the 180° rotation represents a full division sequence cycle....Also, this third detent position is the "home" position of the sequence cam shaft when the division control arm is inactive. The division control arm, however, is still active...therefore, as the push/pull etc...link cam follower moves into the low part of 2nd cam the shift clutch is released...and the div. sequence starts again.

Also, in this position 180° the 6th cam lobe contacts roller on rear of division trip cam holding pawl releasing the trip cam which restores under spring tension.

At the end of the shift cycle the single toothed disc feeds the sequence cam shaft....The machine then adds complements...until a "9" in the 21st reg. gear causes the slideable feed tooth to detent the sequence cam shaft...the machine then cycles plus once, adding the true figure and the fixed feed finger detents the sequence shaft... the selector carriage again shifts one column to the right and this sequence continues until the selector carriage reaches its 1st position.

As the selector carriage is shifted from the 2nd column into the first by the shift clutch, the single tooth disc feeds the division sequence cam shaft before the left end of the shift slide releases the div. control arm.

The 6th cam lobe has allowed the division cam holding pawl to engage the trip cam. Its right extension engages the lug on the hold-up link. This will keep the link active even though the shift slide releases the div. control arm as the selector carriage reaches its right end position. Restoring of the div. control arm allows the single tooth disc to restore by spring tension.(inactive). The rear lug of the div. control arm moves into blocking position of push/pull link clamp arm. The machine adds complements until trip occurs... division sequence cam shaft is detented...then the true figure is added for correction stroke. At the end of correction stroke the fixed feed finger moves the division sequence shaft to neutral (division calculations are finished). In neutral position, the 6th cam raises the division trip cam holding pawl and its right extension releases the hold-up link...which, on its forward movement, disengages hold-up latch from main clutch pawl...to start quotient cycle.

"Zero Division"

If the division key is depressed without figures entered in the selector, or if a carry failure occurs, the mechanism described below has been provided to prevent a "runaway" (division cycling without a carry-over signal...no. "9" in 21st column reg. gear).

The division trip cam feed pawl will feed the division trip cam to the 11th tooth position, the trip cam latch will rest on top of the "hump" of the trip cam. With the division trip cam in this position a roller will move into a dwell on the rear side of division trip cam...originating a trip. On the following correction stroke, the division trip cam will be fed one more tooth (12 in all) and the trip cam latch will drop behind the hump on the division trip cam. As the division sequence shaft is positioned at the end of each correction stroke, the 6th cam lobe will raise the division trip cam holding pawl out of engagement with the division trip cam allowing the cam to drop back one tooth where the hump on the division trip cam, will limit against the division trip cam latch. The division trip cam will be held in this tripped position. So the machine will minus/plus and shift in each column until the selector reaches the right hand position and stops the division calculation cycling. Then on the quotient cycle, as the main cam shaft rotates, an extension on the crank arm on the left end of the D shaft contacts the lower extension of the division trip cam latch...releasing the trip cam which will restore to neutral under spring tension.

When the division trip cam was fed 11 teeth, the M/Q gear made a complete revolution plus one tooth and...on the correction stroke that one tooth was moved in a subtractive direction to zero. Then in each column, the M/Q gear is fed a plus one and a minus one back to zero. So...on the quotient cycle only a quotient symbol (*) will print...since the M/Q gears were all at zero at the end of the division calculation.

Note: During a "zero division", once the trip cam has been rotated 11 teeth, the slideable feed tooth on the carry shaft is always held by its spring in zone with the 3rd cam on the sequence cam shaft. If this 3rd cam were flat, it would jam against the slideable feed tooth whenever the sequence shaft was detented by the single tooth disc on the shift cycle....To prevent such a jam, the leading edge of the 3rd cam is formed at an angle (resembling a propeller blade). Therefore, as the sequence shaft is detented by the single tooth disc, this angular forming on the 3rd cam cams the slideable feed tooth to the left....Subsequently, as the selector cycles in "minus" the slideable feed tooth turns forward of the 3rd cam...is pushed back to the right by its spring...then comes up behind the 3rd cam and detents the sequence shaft to the next position.

Quotient Cycle

As the hold-up latch releases the main clutch pawl, the main cam shaft is allowed to rotate.

Remember, the division program shaft had set program slides:

#1 Quotient Total

#13 Shift/cycle clutch trip

#20 Repeat

Negative total/total (*) symbol slide (2-3) full right

The quotient total program slide moved the quotient total control slide forward...which raised the quotient control bail...which raised the rear latch on #2 operating slide into engagement with the lower extension of the M/Q engaging segment. Also, a lug on the quotient control slide shifts the decimal positioning bail half right.... Lower decimal bar will be operated....The decimal positioning bails also pivot. (The reason for pivoting the outer bail will be covered in quotient transfer). The forward movement of the #2 operating slide engages the M/Q gears with the racks before they start rearward.

During rearward movement of racks, the quotient gears are stopped by the quotient total bail...(zero stop bail on M/Q gear shaft holds racks to left of M/Q gears at zero position). Symbol prints...quotient prints around decimal. (lower decimal bar) Racks are aligned ...M/Q gears and zero bail are disengaged by #2 operating slide before racks move forward.

Near the end of the quotient cycle the program feed plate moves to the right...displacing the program cam shaft to its 4th active detented position.

#1 Quotient total restores

#13 Shift/cycle clutch trip restores

#20 Repeat is held

Since #20 program slide is held, the main cam shaft clutch latch is held up. Therefore, the main cam rotates into the next cycle (Remainder) without interruption.

Remainder Cycle

During the first 24° of the next main cam shaft rotation, the program feed plate moves to the left displacing the division program cam shaft to its 5th active detented position.

#20 Repeat restores

#9 Register total is activated

#14 Hold-up latch disabling is activated

Remainder symbol (R) slide (10) moves full right.

Register total program slide moves its control slide forward, the rearward hump raises control bail which raises the register total latch on #2 operating slide into engagement with lower extension of register engaging segment. #14 program slide moves to left operating a bell crank to raise hold-up latch.

#2 operating slide moves forward engaging register gears with racks before racks start to move rearward.

As racks move rearward, the register gears are totalized, remainder and symbol (R) prints.

Remainder decimal is controlled by upper decimal bar.

Near the end of this cycle, the program feed plate moves to the right, displacing the division program cam shaft to its 6th detented position (neutral).

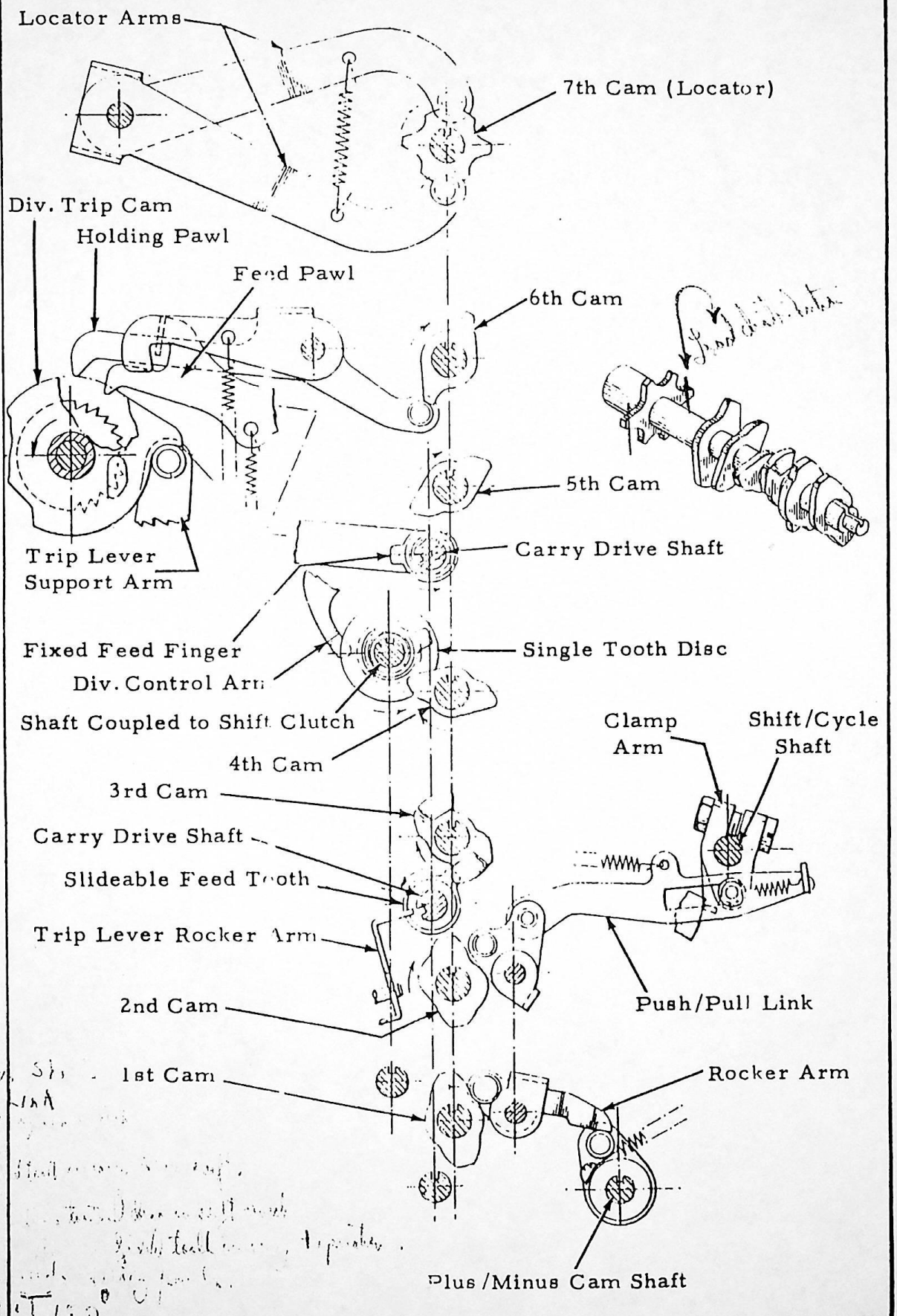
#9 Register total restores

#14 Hold-up latch disabling restores

#10 Symbol slide restores

Cam on main cam shaft clutch restores keystem locking bail. This releases the division key, which allows clutch release bail, division activating bail, division program shaft feed finger, etc. to restore.

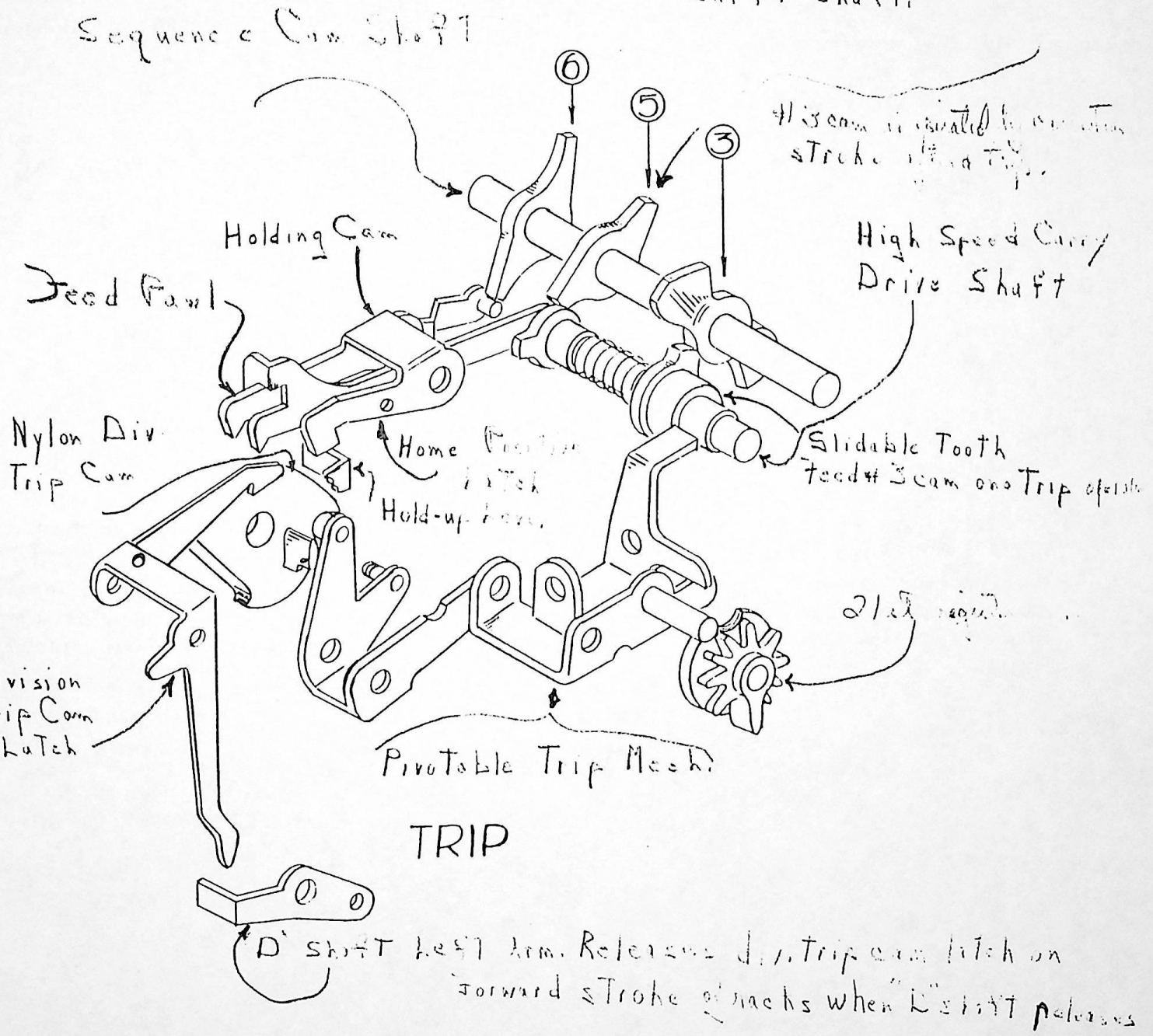
DIVISION SEQUENCE CAM SHAFT
(Shown in "Home" Position)



4 When operated by single tooth D disc on shift shaft operates feed pawl down 1 - operates shaft for complete side shift - operates the detent shaft for engaging the cam

REFERENCE VIEW

#5 Cam - is operated by single tooth disc on shift shaft.


Sequence Cam Shaft
6
5
3
#3 cam is operated by one stroke of the trip.
Holding Cam
High Speed Carry Drive Shaft
Feed Pawl
Nylon Div. Trip Cam
Home Position Latch
Hold-up Lever
Slidable Tooth feed #3 cam one Trip operation
2nd & 4th
Division Trip Cam Latch
Pivotable Trip Mech.
TRIP
"D" shaft left arm. Releases div. trip cam latch on forward stroke of knobs when "D" shaft releases

Division Key ÷

Constant divisor/quotient transfer lever at * x (Transfer Quotient).

There are two lower extensions on the constant divisor/quotient transfer bail. When it is active the right extension moves the division intermediate rod rearward (see IV-B-2) positioning a sliding cam on the division program cam shaft rearward... effecting division function as follows.

At the start of the first main cam shaft cycle, the program cam shaft is detented one position (60°)... same as normal division. However, the program is different because the division intermediate rod is active. The exception is... symbol slide (7) for (x) constant divisor is not positioned... only ÷ symbol prints.

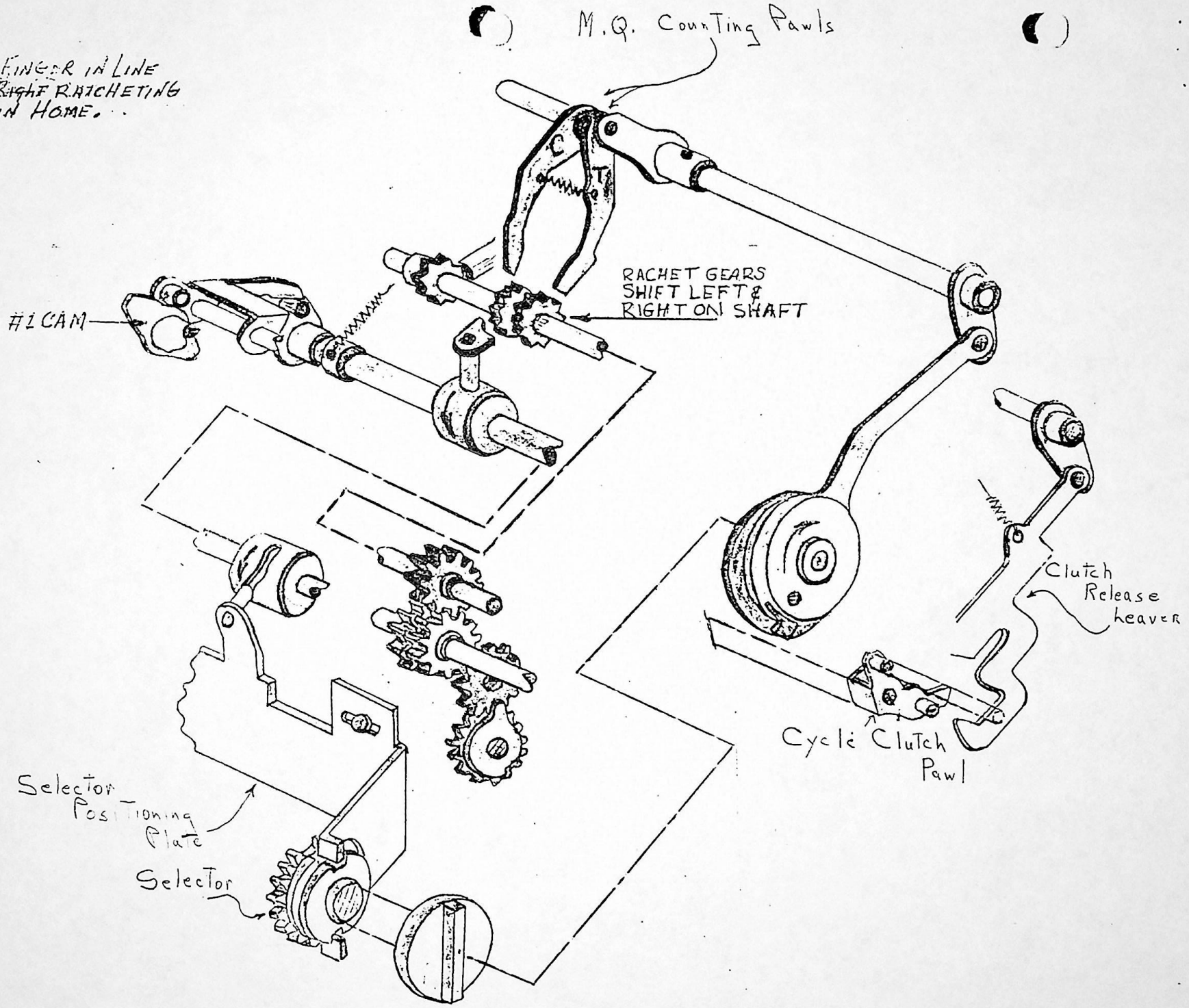
The other exception occurs as the machine programs during the 1st 24° of the 2nd main cam shaft cycle. The following program and symbol slides are set in addition to normal programming.

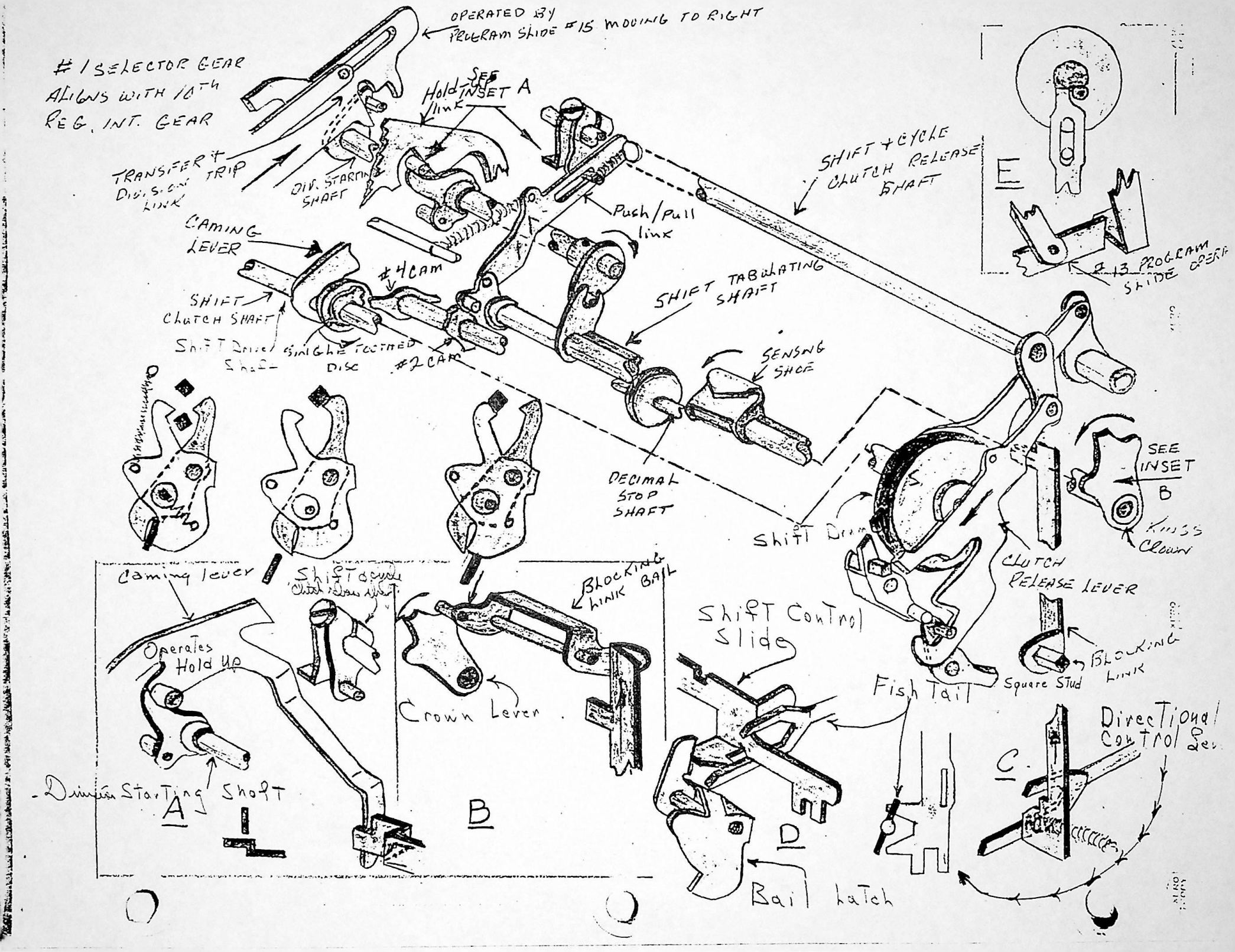
#17 Enter Selector

Symbol slide (7) full right for ×

The quotient will print with * × indicating quotient transfer to selector.

The left lower extension on the constant divisor/quotient transfer bail moved the blocking link out of the path of the release latch for the selector set-up clutch pawl... therefore, since program slide #17 enter selector was activated as mentioned above, the 3 cam cluster will go through a regular set-up cycle... entering the quotient after it is totaled from the M/Q gears into the selector on the return of the racks during quotient cycle.


M.Q. Counting Pawls
NOTE TRUE FINGER IN LINE WITH RIGHT RATCHETING GEAR IN HOME. .
RACHET GEARS SHIFT LEFT & RIGHT ON SHAFT
#1 CAM
Clutch Release Heaver
Cycle Clutch Pawl
Selector Positioning Plate
Selector


#1 SELECTOR GEAR ALIGNS WITH 10TH REG. INT. GEAR
OPERATED BY PROGRAM SLIDE #15 MOVING TO RIGHT
SEE INSET A
Hold link
TRANSFER TRIP
DIVISION LINK
DIV. STARTING SHAFT
SHIFT + CYCLE CLUTCH RELEASE SHAFT
CAMING LEVER
#4 CAM
Push/Pull link
SHIFT CLUTCH SHAFT
SHIFT DRIVE SHAFT
SINGLE TOOTHED DISC
#2 CAM
SHIFT TABULATING SHAFT
SENSING SHOE
DECIMAL STOP SHAFT
E
#13 PROGRAM SLIDE OPER.
SEE INSET B
KNOCK CLOWN
CLUTCH RELEASE LEVER
BLOCKING LINK
Square Stud
Caming lever
Shift drive Clutch release shaft
Operates Hold up
Driving Starting Shaft
A
BLOCKING LINK BAIL
Crown Lever
B
SHIFT CONTROL SLIDE
Fish Tail
D
Bail latch
C
DIRECTIONAL CONTROL SEC.

Division Sequence Cam Shaft Description
From Left to Right

#1 Cam - Operates the plus and minus shaft for positioning the selector to use the true or complement amount.

#2 Cam - For tripping of the shift/cycle clutches.

#3 Cam - Feed cam for sequence cam shaft. It is operated by the moveable feed tooth on the carry shaft when the 21st register gear is at a 9.

#4 Cam - Feed cam for sequence cam shaft. It is operated by single tooth disc on the shift shaft.

#5 Cam - Feed cam for sequence cam shaft. It is operated by the stationary feed finger on the end of the carry shaft. Advances shaft on + correction stroke

#6 Cam - Operates the feed and holding pawls for the division trip cam and the latch for the hold-up blocking link when the selector is in the first position.

#7 Cam - Locating cam for the sequence cam shaft.

Feeding during division

1st. # 4 Feeds sequence shaft on a shift operation by action of shift drum shaft.

2nd. #3 Feeds sequence shaft on a Trip operation via high speed carry drum shaft 21st tooth

3rd. #5 Feeds sequence shaft on trip operation

TRANSFER

Transfer Dividend

In this case we have a direct transfer from the accumulator to the register and the decimal point is always the same in the accumulator and the register.

Transfer Multiplicand

When we transfer a multiplicand, we transfer from the accumulator to the selector and in some cases the selector has to be moved to the left before transferring so that the decimal point will correspond. The selector has to move one place to the left for each decimal position of the multiplier. For example, suppose we are set up for two decimal places in the multiplicand and two in the multiplier. The product would be four decimal places as shown below:

Multiplicand (selector)	xxx. xx
Multiplier	xx. xx
Product	xxxxx. xxxx

You can see that since the selector, at the start of multiplication, is always at the extreme right that we have to move the selector two places to the left before transferring so that the decimal points will correspond. The selector then has to move back to its home position before the machine starts to multiply. Now suppose that we are set up for three decimal places in the multiplicand and two in the multiplier. We would then have five places in the product, as shown below:

Multiplicand	xxx. xxx
Multiplier	xx. xx
Product	xxxxx. xxxxx

You can see that we still have to move the selector two places to the left before transferring. Now, let us suppose that the multiplicand is set up for two places and that the multiplier is set up for three places, which means the product would have five decimal places, as shown below:

Multiplicand	xxx. xx
Multiplier	xx. xxx
Product	xxxxx. xxxxx

You can see that now the selector has to be shifted three places to the left before transferring. It is the number of decimal places in the multiplier that controls the number of places that the selector has to be shifted to the left. What the machine does on transferring a multiplicand is this:

The selector shifts left the corresponding number of places. The number of places it shifts to the left is controlled by the tab stop shaft which is connected to the multiplier decimal stop shaft by a timing belt. The left shift is similar to the left shift in division. When the selector reaches the proper left hand position, the hold-up latch is released and the amount in the accumulator is totaled out and set up into the selector.

In transfer multiplicand), the left dec control knob will control the number of places the selector will shift to the left before it resumes the transfer.
The right dec control knob will control the number of places that will be transfered to the selector.
decimal

Multiplicand Transfer Function
Total / sub-total lever in total position
Transfer key drives decimal bail to right to inactive position
Transfer program bail rearward drives:

Release blocking link rearward by rear end of Transfer Program bail disabling gravity latch.

During 1st 24° Transfer Program bail operates:
#6 Accumulator Total
#2 and #3 Neg. total / total symbol slides are driven full right to print "*" and controls the left symbol rock.

The sliding bail on the Enter Multiplicand program bail is driven rearward causing the following to be activated or to be inactive as indicated during 1st 24°

Inactive:
#5 Set-up carriage escapement
#4 Set-up carriage engagement
#7 Set-up carriage return

Activated:
#17 Enter selector
#13 Shift / cycle clutch trip
#15 Transfer / Division trip
#7 Multiplicand Symbol slide for printing of "X"

With the total / sub-total lever in Sub-total position causes:

#18 Transfer total and sub-total (acc.) program slide moves left in the path of the sliding bail on the Transfer program bail, blocking its rearward movement causing the following to be selected.

#11 Total / sub-total cam program slide (to sub-total position).
#5and #6 Neg. sub-total / Sub-total symbol slides are driven full right to print " " and controls the left symbol slide.
#6 Accumulator total active (not affected by total and sub-total slide.)

Dividend Transfer

Total/Sub-total lever in the total position.
Transfer key drives the decimal bail to the right to its inactive position.
Transfer program bail to the rear drives the following:

Release blocking link moved rearward disabling the gravity latch.
#6 Accumulator Total.
#2 & #3 Neg total/total symbol slide is driven full right to print (-) and controls the left symbol rack.

Through connection of the Enter Multiplicand program bail the sliding bail on the Enter Dividend program bail is driven rearward causing the following to be active or inactive as indicated:

Inactive:
#5 Set-up Carriage escapement.
#4 Set-up carriage engagement.
#7 Set-up carriage return.

Active:
#14 Hold-up latch disabling.

In addition, the following are activated when the Enter Dividend program bail is rearward:

#19 Enter dividend.
#1 Dividend symbol slide is driven full right to print (÷) and controls the right symbol rack.

With the total/sub-total lever in the sub-total position causes:

#18 Transfer total/sub-total (Acc.) program slide moves left in the path of the sliding bail on the transfer program bail, blocking its rearward movement causing the following to be selected:

#11 Total/sub-total cam program slide (to sub-total position).
#5 & #6 Neg Sub-total/Sub-total symbol slide is driven full right to print (*) and controls the left symbol slide.

#6 Accumulator total active (not affected by the total/sub-total program slide).

The same program slides will be selected when the Enter Dividend key is depressed as indicated above.

Low order digits in the accumulator to the right of the first selector gear will be dropped. It is also possible to have high order digits in the accumulator beyond the multiplicand capacity and these will be lost if a transfer is made. After the setup, the machine then goes into a right shift operation and the selector shifts right to the home position at which time the machine stops. This right shift is similar to the right shift of multiplication. In the detailed description that follows it will be assumed that the multiplier is set for at least one decimal place. The action is different and will be described later if there is no decimal place in the multiplier.

It was pointed out earlier that program slide 15, division and transfer tab stop, was the only slide that is operated both right and left. It is moved to the right in division, which in turn moves the tab. trip link to the rear. The stud of the trip arm fits in the slot in the link. When the transfer and enter multiplicand keys are depressed simultaneously, program slide 15 moves to the left. This pulls the link forward instead of pushing it backward as in division. When the link is pulled forward... the tab. trip shaft rocks counterclockwise. The tab shaft is then rocked clockwise so that stud of bail drops into forward notch instead of rear notch of tab shaft locator arm. However, the slide is raised the same as it is in division and will hold shift fishtail in the left shift position even though the shift slide will move away from the fishtail to the left. A stud is riveted to middle trip arm and when the trip shaft is rocked counterclockwise by trip link, the stud moves to the rear and contacts hold-up link. This moves link back into the hold-up position. Program slide 13 is also operated when the transfer and multiplicand keys are operated together. This moves the shift and cycle clutch trip control slide to the rear and trips the shift clutch just as it does in multiplication. The scissors latch the clutch release lever. When the shift slide moves to the left as the carriage moves out of its first position, the scissors are permitted to rock clockwise.

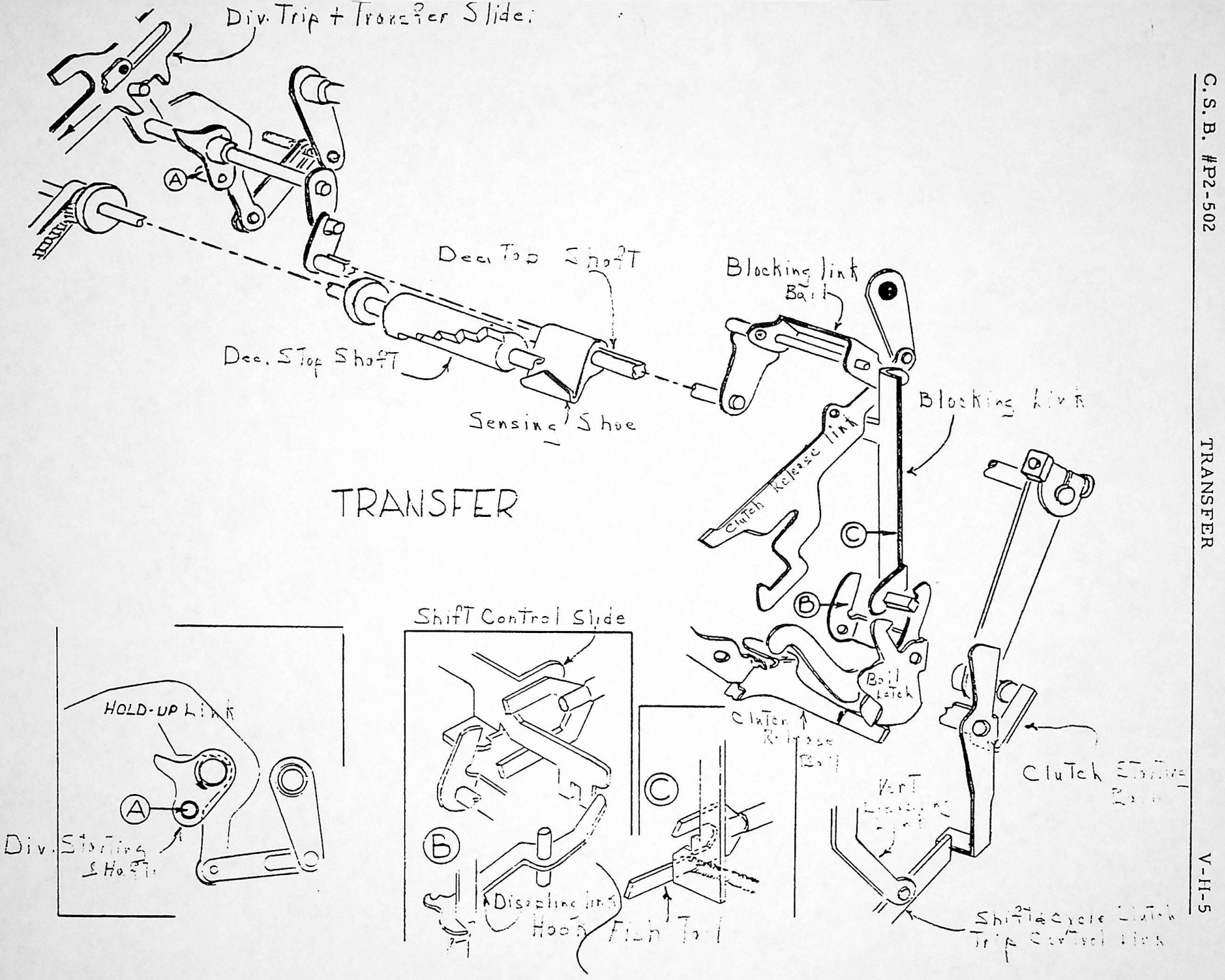
In division, when the tab shoe strikes the roller, it cams tab shaft clockwise into its home position. The tab stop drum is to the right of the roller on tab shaft. The transfer tab shoe is similar to the div. tab. shoe, and it moves left with the carriage. When tab shaft is rocked clockwise as it is in division, the div. tab shoe is in position to engage roller. When it is rocked counterclockwise for a transfer, the transfer tab shoe is in position to engage one of the stops on the right hand end of the tab shaft. The carriage shifts left until the tab shoe contacts one of the stops. When this happens, the transfer tab shoe is cammed counterclockwise by the stop which rocks the tab shaft locator arm counterclockwise from the transfer to the home position. This pivots the bail and lowers blocking slide. When the diamond stud goes down between the points of the scissors, the scissors will open just as they will in automatic division. This restores the clutch release lever and stops the shift. At the same time, the trip shaft is restored to its home position and the hold-up link moves forward and releases the hold-up latch. The main shaft completes its cycle and since program slide 6 (or 11) and program slide 17 have been operated, the amount in the accumulator is transferred to the selector. When the shift slide moved left, the release latch engaged the vertical disabling link which in turn holds the shift and cycle clutch trip control slide in the rear position and keeps the keyboard locked even after the main shaft completes its cycle (the same as in multiplication).

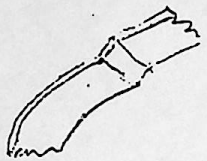
The transfer arm is attached to the right end of the selector raising and lowering shaft. This is the shaft which carries the arms for moving the selector up into mesh with the clearout gears and down into mesh with the racks. The clutch starting bail, besides working as described in automatic multiplication, also moves left and right. This bail has a rearward extension and an upward extension. It is moved left and right by the shift slide. A plunger stud is on the lower end of the transfer arm. The stud may also be moved left by compressing its spring. In the home position the stud is all the way to the right and the rearward extension of the clutch starting bail is opposite the head of the stud, but to the right of it so that they clear each other. When the carriage starts to shift to the left, the shift slide moves to the left, which in turn moves the clutch starting bail to the left. The left end of the rearward extension contacts the head of stud and moves it to the left, compressing the spring. After the carriage is shifted to its left hand position, the main shaft starts to complete its cycle...tripping the selector setup clutch. The selector moves up into mesh with the clearout gears and the transfer arm moves clockwise. After the selector gears are cleared they move down to mesh with the racks. The transfer arm then moves counterclockwise far enough for the edge of the stud to come behind the rearward extension. This releases the stud and its spring moves it to the right. Now, when the transfer arm moves back to its home position, the edge of the stud will contact the rearward extension, pivoting the clutch starting bail counterclockwise which again trips the shift clutch. Since the shift slide is left, the clutch release lever is latched by the bail latch of the scissors. However, the blocking slide moved down when the carriage reached its left hand position. Thus it no longer holds shift fishtail in the left shift position and spring tension pulls the fishtail into the right shift position. With the shift slide left, the carriage shifts right. When it moves into the home position, the shift slide moves right moving the clutch starting bail right so that its rearward extension clears the head of stud on transfer arm. Thus the clutch starting bail is released. Also, when the shift control slide moved right, the scissors rocked counterclockwise. This opens the scissors which allows clutch release lever to restore the clutch selecting cam. Also, the release latch is moved to the unlocked position which releases the shift and cycle clutch trip control slide, which unlocks the operating keys and we have completed the transfer.

If there is no decimal point in the multiplier it is not necessary to shift the selectors to the left. Actually, the do shift one place left and then back to the home position befor the main shaft completes its cycle. This is unnecessary, but from the design standpoint was simpler than to completely disable the shift if there is no decimal point in the multiplier. The gear on the left end of the tab stop shaft is rotated by the timing belt connecting it with the multiplier decimal stop shaft in the decimal unit in the front of the machine. In the zero decimal position, the back end of the tab trip link is raised so that the stud of the trip arm is out of the slot. If the link is then pulled forward, it will not operate the tab trip shaft. The link is held up in the zero decimal position by a disabling bail. When the bail is in its counterclockwise position, it holds the back end of the link up so that it will not operate the trip arm when pulled forward. The right side of the gear has a cam surface. In the zero decimal position this cam contacts the disabling bail and holds it in the counterclockwise position. In any other position, the disabling bail is positioned clockwise and this lowers the back end of link so that the stud is encompassed by the slot and will then be operated if the link is pulled forward for transfer. When the back end of the link is

up, its "nose" is in position to contact the back edge of the zero transfer bail. In this position, when the link is pulled forward for transfer its "nose" will rock the bail counterclockwise. An edge of the bail contacts a lug of the holdup link and moves the link rearward to the hold up position. A worm is located on the left end of shift extension shaft. The zero transfer bail is free to move left under spring tension. When it is rocked counterclockwise, its "leg" moves down into the threads of the worm and, as the shift shaft rotates, the bail will be moved to the left. When the machine starts to cycle the shift clutch is tripped and the scissors are latched the same as previously described. However, the blocking slide has not been raised and as soon as the shift slide moves left away from the upper fin of the shift fishtail, the fishtail moves to the right shift position. Also the scissors rocks clockwise. The second cycle is a right shift which moves the shift slide right. This restores the shift clutch at the end of the second cycle the same as at the end of a decimal transfer except that in the case of a decimal transfer the shift clutch is restored after the selector set up. In this case it occurs before the set up. After two turns of the shift shaft (during which time the carriage shifts one space left and then one space right) the "leg" of the zero transfer bail is moved far enough left to release the lug on the hold-up link. This link then moves forward and releases the hold-up latch. The clutch mechanism on the right side of the machine is operated the same as described above. When the hold-up link is released, tripping the hold-up latch, the main shaft completes its cycle and sets up the amount from the accumulator into the selector. In this case the carriage does not have to move right since it has done so previously, and the operating keys are unlocked as soon as the main shaft completes its cycle.

A slide, at the back of the left hand control keyboard, is cammed right by the transfer key. This moves the decimal bail to the right. When the decimal bail is in this position the notches which are normally to the left of the keys are under the keys and if a key is then depressed the decimal bail will not be operated. Ordinarily any operating key latches the decimal bail down if it has not already been latched down by the decimal key. This is done as previously described to properly position the set up carriage according to the decimal setting. However, when we transfer we do not want to operate the decimal bail since when we transfer a dividend the decimal point is in the same position as in the accumulator, or if we transfer a multiplicand the selector has to be positioned according to the multiplier decimal set up, as described above.


Div. Trip + Transfer Slide
A
Dec. Top Shaft
Blocking link Ball
Dec. Stop Shaft
Sensing Shoe
Blocking link
Clutch Release link
TRANSFER
C
B
Shift Control Slide
Ball latch
Clutch Release Ball
Clutch Starting
HOLD-UP LINK
A
Div. Starting Shaft
B
C
Disabling link
Hook
Fish Tail
Shift Cycle Clutch Trip Control Link

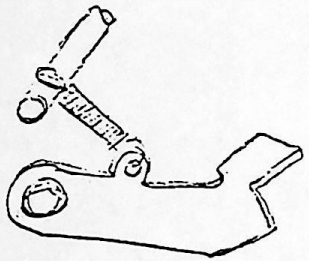


CARRIAGE REMOVAL

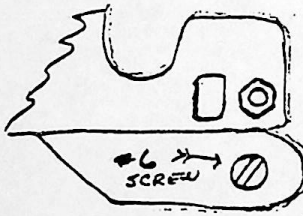
(1)

DOUBLE SPACE CONTROL BAIL

REMOVE CLIP FROM STUD (a) AND MOVE THE LINK FROM THE STUD.

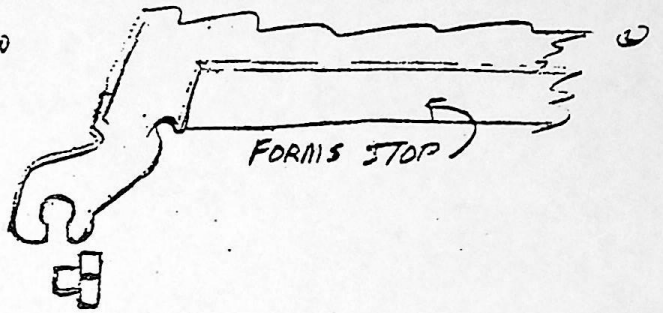
(2) 

DISCONNECT THE SPRING ON THE PAPER SPACE PANL FROM STUD.

(3) 

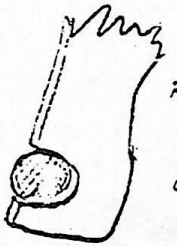
L.H. CARRIAGE END PLATE

REMOVE A #6 SCREW FROM THE L.H. AND R.H. CARRIAGE END PLATE.

(4) 

BACK OFF SHOULDER NUT ON REAR R.H. AND L.H. SIDE OF THE FORMS STOP PLATE.

PIVOT THE CARRIAGE REARWARD UNTIL FREE AND LIFT FROM THE MACHINE.



REAR OF CARRIAGE END PLATE

CARRIAL PIVOTS ON A STUD ON EACH SIDE

To remove the Numeral Key Board:

1. Remove the small toggle spring on the RH side of the Right Control Key Board.

2. Remove screw from the RH side of the Right Control Key Board and remove the two front bails.

3. Remove the Clear key top and the Decimal bar key top.

4. Remove 2 screws and lock washers from the rear of the Numeral KB.

5. Loosen 2 locking brackets from the front of the Numeral Key Board.

6. Un-hook the small spring from the front lower RH corner of the Numeral KB.

7. Remove the numeral KB.

8. Remove the Locking Bar to prevent its loss.

To replace the Numeral KB.

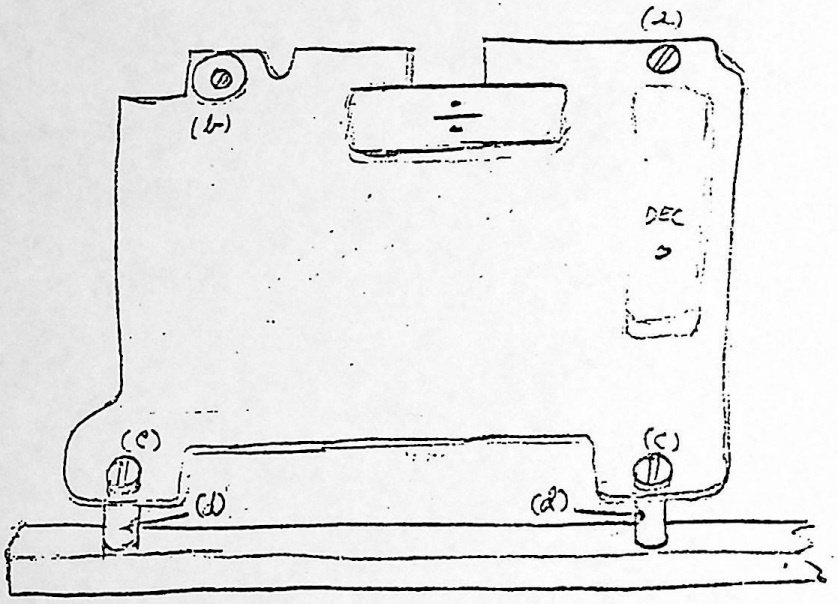
1. Replace the Locking Bar.

2. The two ears on the back of the Numeral KB must be inserted into two slots.

3. Reverse the above procedure.

1-20 67

L. H. Operating, K.B



① Remove the #6 screw (2)
② Remove the rubber cushion and washer (b)
③ Remove screws (c) and rubbers (d)

Lift K. B. up and out.

(1)

(page 1)

The Following Program Bails drive the listed Program Slides:

Clear Program bail:
- #4 Set-up carriage engagement (and locks numeral KB and decimal key).
- #7 Set-up carriage return (and moves the decimal bail to the right).
- #12 Non-print/non-space
- #14 Hold-up latch disabling.

Non-Add:
- #4 Set-up carriage engagement (and locks numeral KB and decimal key).
- #7 Set-up carriage return (and moves the decimal bail to theright).
- #14 Hold-up latch disabling.
- #4 non-add symbol slide full right (controls #1 symbol rack).

Plus:
- #2 Accumulator plus and minus engagement.
- #5 Set-up carriage escapement (and drives #4 below).
- #4 Set-up carriage engagement (and locks numeral KB and decimal key).
- #7 Set-up carriage return (and moves the decimal bail to the right).

Minus:
- #2 Accumulator plus and minus engagement.
- #5 Set-up carriage escapement (and drives #4 below).
- #4 Set-up carriage engagement (and locks numeral KB and decimal key).
- #7 Set-up carriage return (and moves the decimal bail to the right).
- #3 Minus accumulator program slide.
- #8 Multiply Minus symbol slide full right (controls #2 symbol rack).

Repeat and Square:
- #11 Total/sub-total cam program slide.

Total:
- #6 Accumulator total
- #14 Hold-up latch disabling.
- #2 & #3 Neg total/total symbol slides are driven full right. #2 will yield and move only half way on a CR operation. (controls #2 symbol rack).

To remove the Left Control Key Board:

1. Remove the front 2 screws and 2 long spacers.

2. Remove screw and rubber grommet.

Caution: Watch spacer below grommet.

3. Remove screw and lock washer from RH rear corner of KB.

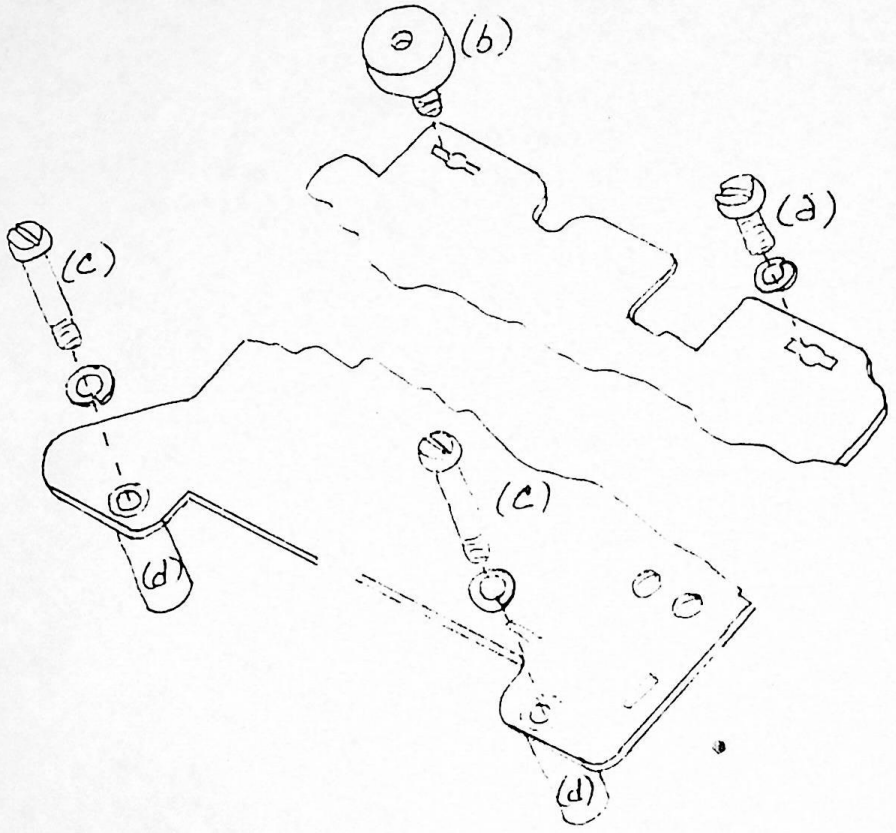
To replace the Left Control Key Board:

1. Tip the machine well forward (lift the back).

2. Install the KB making sure that the three bell cranks are in place on the Program Bails. Be sure the LH Disabling Lock is to the right of the Neg. Equals keystem.

3. Reverse the above procedure.

L.H. Operating K.B

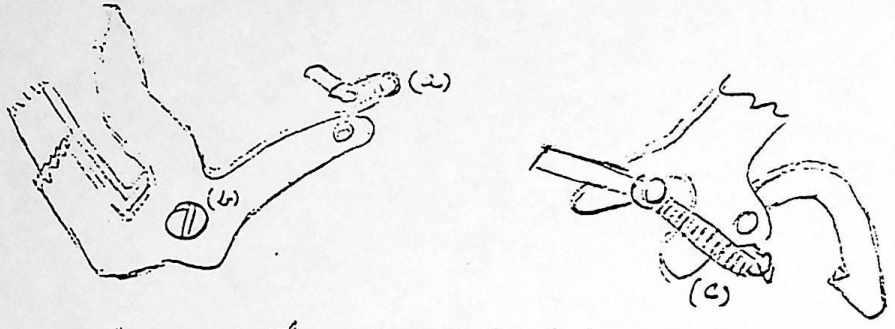


1. Remove the #6 screw (a)
2. Remove the rubber coushion and washer (b)
3. Remove screws (c) and collars (d)*

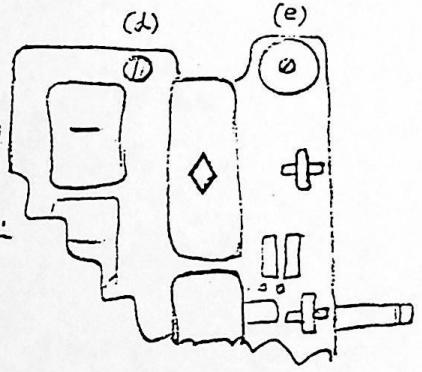
   Lift K.B. up and out.

* On new style these collars are riveted to top plate

REMOVE R.H. OPERATING K.B. 7-20 (3)



1. Remove toggle spring (a)
2. Remove spring (b)
* 3. Remove screw stud (b)
4. Remove the Quotient Total Transfer and multiplier arc. contact links from their L.H. pivot screw.

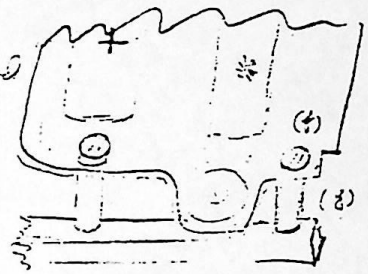


5. Remove 2006 screw (2) and screw out the rubber cushion (e)

* It is not necessary to remove the links to remove the R.H. Operating K.B. However, if the numeral K.B. is to be removed it makes

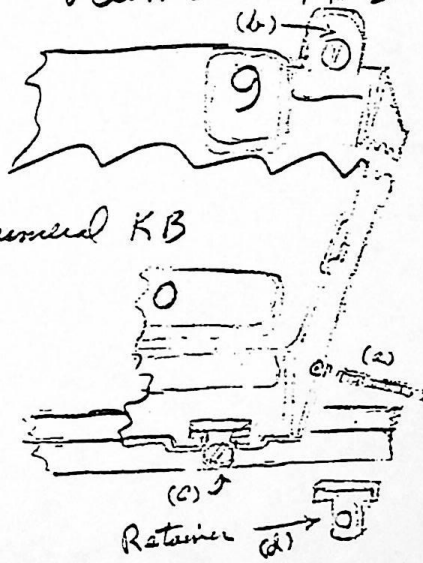
it easier to loosen the front retaining screw if the links are removed.

6. Remove the two long screw (4) and spacer collars (8) from the front of K.B.



Lift K.B. up and out of the machine

Numeral K.B.



① Disconnect the spring (a) from the R.H. side of K.B.

② Remove the 2 # 6 screw (b) and 2 lock washers from rear of K.B.

③ Loosen the two # screws (2) and move the retainers (2) free of the K.B. bottom plate

Lift K.B. up and out

To remove the Right Control Key Board:

1. Remove a tru-arc from interlock (below the RH rear corner of the KB.

2. Remove a toggle spring from the RH side.

3. Remove a light spring from the RH side.

4. Remove a screw and lock washer below the Minus key top.

5. Remove a screw and rubber grommet from the RH rear corner of the KB.

6. Remove two screws and 2 long spacers from front of KB.

To replace the Right Control Key Board:

1. See that the two Program Bell cranks are in place.

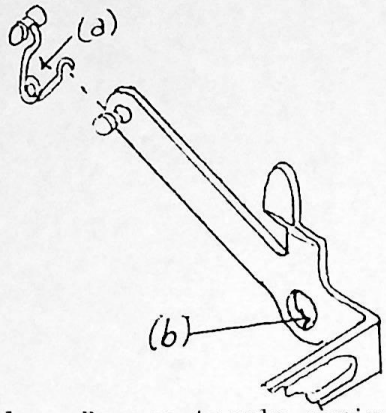
2. Make sure that the RH Disabling lock is to the left of the Sub-Total key stem.

3. See that the arm on the decimal shaft is under the plus and the minus key.

4. Install the toggle spring so that the loop is towards the rear of the machine.

5. Reverse the above procedure.

Remove R. H. Operating K.B.



1. Remove toggle spring (a)

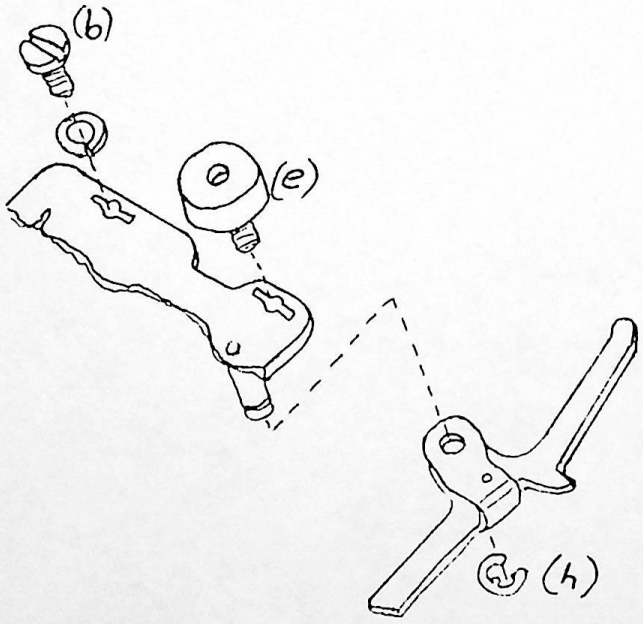
2. Remove spring (c)

3. Remove screw stud (b)

4. Remove the Quotient Total Transfer and Multiplier acc. Control bails from their L.H. pivot screw.

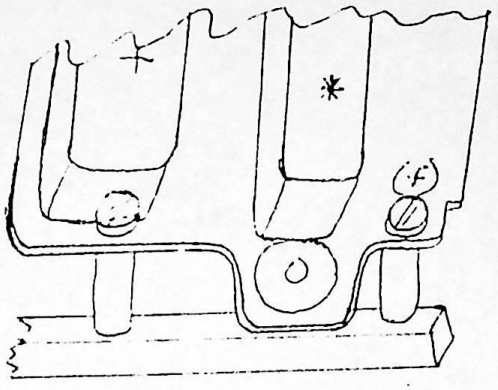
5. Remove 2006 screw (b) and screw out the rubber coushion (e)

Remove tru-arc (h)



* It is not necessary to remove the bails to remove the R.H. operating K.B. However, if the numeral K.B. is to be removed it makes it easier to loosen the front retaining screws if the bails are removed.

6. Remove the two long screw (f) and space collars (g) from the front of K.B.

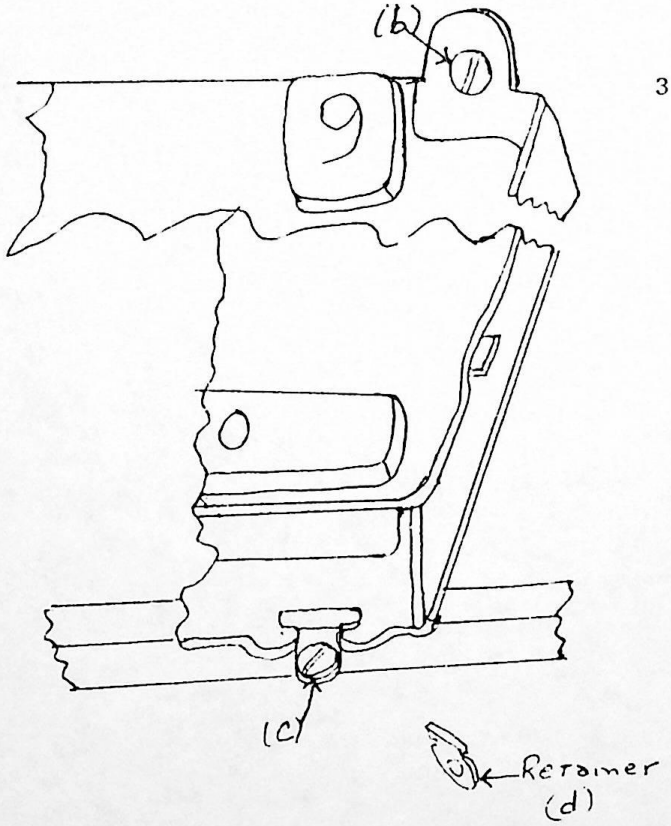


Lift K.B. up and out of the maching

1. Disconnect the spring (a) from the R.H. sid of K.B.

2. Remove the 2 # 6 screws (b) and #70 lock washers from rear of K.B.

3. Loosen the two #6 scres (e) and move the retainers (d) from the K.B. bottom plate



Lift K.B. up and out

To remove the Set-up Carriage:

1. Remove the front rail.

2. Remove the minus key top.

3. Remove the Decimal Indicator.

4. Remove 2 springs from set-up carriage.

5. Loosen and turn the shaft brace up.

6. Remove taper pin from gear on the R.H. end of the Set-up Engaging shaft. OPTIONAL

7. Remove tru-arc from the R.H. end of the Set-up Engaging Shaft (Inside the square plate).

8. Move the shaft to the right out of the set-up carriage.

Caution: Watch for shim on the shaft between the tru-arc (removed in 7 above) and the square plate.

9. Turn a Decimal Indicator to 7.

10. Move the Set-up Carriage to the left and rock forward and remove.

To replace the Set-up Carriage:

1. Reverse the above procedure.

2. After installing the unit, check timing of set-up carriage engaging rack just as the racks start to move.

To remove the Set-up Carriage and the Square Plate:

1. Remove right control KB.
2. Remove the decimal escapement lever (2 tru-arcs, 1 spring).
3. Remove long screw stud and lock washer from the square plate.
4. Remove the ratchet pawl and switch closing link.
5. Remove the rolled pin.
6. Remove the set-up carriage positioning link (1 tru-arc).
7. Remove the front rail.
8. Remove the KB interlock.
9. Remove the gear and taper pin from the R.H. end of the set-up carriage engaging shaft. (OPTIONAL)
10. Un-hook a spring from a stud behind the square plate.
11. Remove a tru-arc on engaging shaft from the R.H end & remove shaft. Watch for shim on shaft.
12. Un-hook spring on decimal carriage.
13. Remove the decimal indicator.
14. Un-hook tab spring.
15. Remove the square plate.
16. Remove the stop shaft.
17. Remove the set-up carriage and shaft.

To remove the Accumulator Barrel assembly:

1. Remove three tru-arcs and two washers.

2. Work the Acc. support plate up and out of the machine.

3. Remove the Acc. barrel.

Caution: Watch for shims on each end of the unit. The shims may stick to the plate and L.H. bearing.

Watch for the pin in the L.H. end of the Acc. unit.

Note: The detent bail contacts the negative Acc. gears.

Replacing the Acc. unit:

1. Replace the Accumulators with the shims in their original position. (Some shims are different thickness and are used to zone the Accumulators L. & R. with respect to the racks and the selective carry-over fingers.)

2. Replace the plate.

3. Time the accumulator positioning gear segment.

To remove the carry-over unit and operating slides:

1. Remove the motor.
2. Carriage may be removed if desired.
3. Remove the bottom frame.
4. Take the belt (to the high speed unit) off of the idler pulley.
5. Remove the tension spring from the idler pulley.
6. Remove the bracing plate (just above idler pulley) including:
   a. 1 hex stud and lock washer.
   b. 1 2006 screw and keeper.

With machine upside down:

7. Remove 2 tru-arcs and the plus and minus acc. throwing links.
8. Remove 2 tru-arcs and disconnect all three operating slides.
9. Un-hook 1 spring on #3 operating slide.
10. Loosen screw on hi-speed unit to allow frame to be sprung out.
11. Remove 2 screws and 2 lock washers from the R.H. side of the carry-over unit (long screw to the rear).
12. Remove 1 spring from the register segment.
13. Remove the gear that meshes with the register segment.
14. Remove 1 tru-arc from the carry-over bail link and disconnect.
15. Remove 1 tru-arc from the D shaft link and disconnect.
16. Remove 1 tru-arc from the double space link.
17. Remove the accumulator engaging arm on left end and 1 screw and star lock washer.
18. Remove 2 screws and 2 lock washers from the L.H. side of the carry-over unit (long screw to the rear).
19. Hold the register segment to the rear, spring the frame outboard...remove the unit.

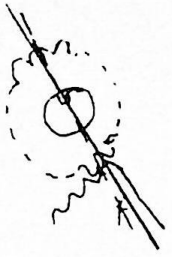
When replacing the unit:

1. Reverse the removal procedure.

2. Check racks for binds with the accumulators in mesh and out of mesh.

3. Time the register segment with gear.

4. Check that accumulators rotate freely.



To remove the Bottom Frame:

1. Remove the compression spring on L.H. side. Non space lever.
2. Remove tru-arc near R.H. rear. } These are on high speed clutch trip link
3. Remove tru-arc near R.H. front. }
4. Remove the switch.
5. Install "S" jig after turning machine upside down. (OPTIONAL)
6. Loosen 2 set screws in collars in upper end of support brackets.
7. Remove 6 screws and 6 lock washers and remove the two support brackets.
8. Move one collar against the non-print lever and secure the screw to keep the lever in place.
9. Remove 15 screws holding frame to machine.
10. Remove the Bottom Frame.

To Replace the Bottom Frame:

1. With a strong rubber band, tie the control bails so that they will remain in their neutral position.
2. Place all of the Control slides in their neutral position.
3. With machine upside down, replace the bottom pan.
4. Reverse the above procedure and make support bracket adjustment.
5. After completing the work, hand crank the machine thru most of the functions.

NOTE: Make sure that the bell cranks on the program unit are seated against the restored Program Slides when through.

NOTE: Make sure that the Red-Print lever is in an aperature in a Control Slide and that the Non-print lever is forward of an offset on a Program Slide.

To remove the Program Unit:

1. Remove all K.B.

2. Remove the Bottom Frame.

3. Remove a screw and lock washer from the L.H. upper corner of the Program Unit.

4. Remove a tru-arc from the rear end of the Clutch Release link and work the stud out of the hole.

5. Remove the Pulley bracket (watch for shim behind the pulley bracket).

6. Remove the Total-Sub-total lever and toggle spring.

7. Remove 3 tru-arcs from the top left of the unit and un-hook the links.

   a. From the Multiplicand Bail.

   b. From the Multiplier Bail.

   c. From the Decimal Bail (Below a and b).

8. Remove a screw and lock washer from the RH upper corner of the Program Unit.

9. Remove the escapment link from the RH side (2 tru-arcs).

10. Remove a large tru-arc from the front end of the switch closing.

11. Un-hook small spring from Ratchet Pawl to RH side frame.

12. Un-hook 1 long spring.

13. Remove tru-arc from connecting link at the eccentric and disconnect the link. Set-up clutch release link.

14. Remove tru-arc from Program Feed link.

15. Remove tru-arc from long link on bottom.

To replace the Program Unit:

1. With the machinge on its back:
2. Place the Program Feed Link up against the cam shaft area.
3. Guide the Program Unit into place.
   a. Total-Sub-total arm in between cams.
   b. 2 capacity locks into guide on left rear top of unit.
   c. Position links to:
      1. multiplicand bail.
      2. multiplier bail.
      3. decimal bail.
   d. Watch Clutch Release Link.
   e. Watch Switch closing link.
4. When located, put 2 screws and lock washers in both rear upper corners of unit but do not tighten firmly.
5. Numeral K.B. may be installed to stabalize Program Unit.
6. Replace all tru-arcs and links removed.

After replacing the Program Unit:

Check the Sub-Total-total cam for L & R engagement with the cam follower during:

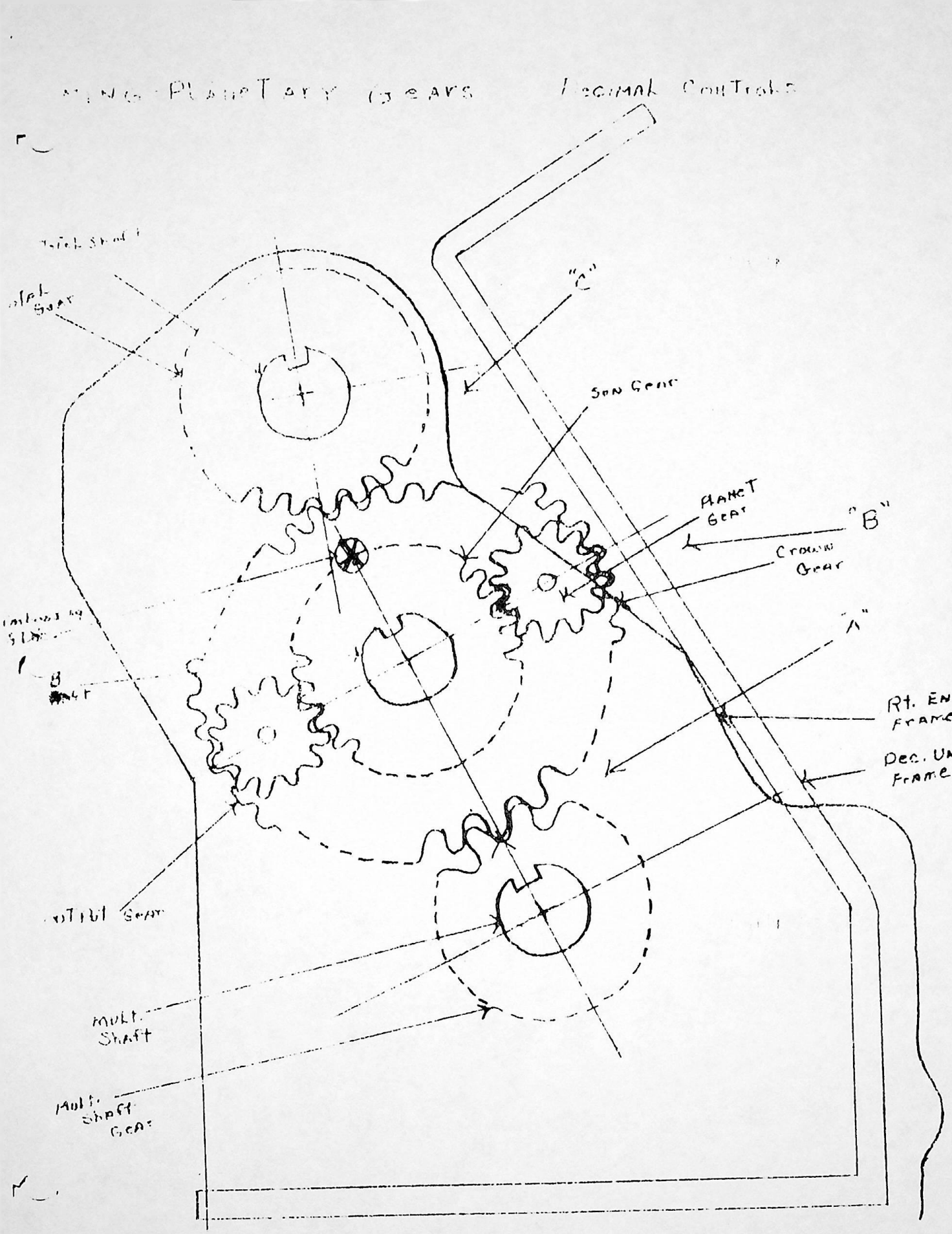
1. Clear Operation.
2. X with Square.
3. Sub-total operation.

Crank the machine thru by hand thru several functions before plugging the machine in.

To remove the decimal unit:

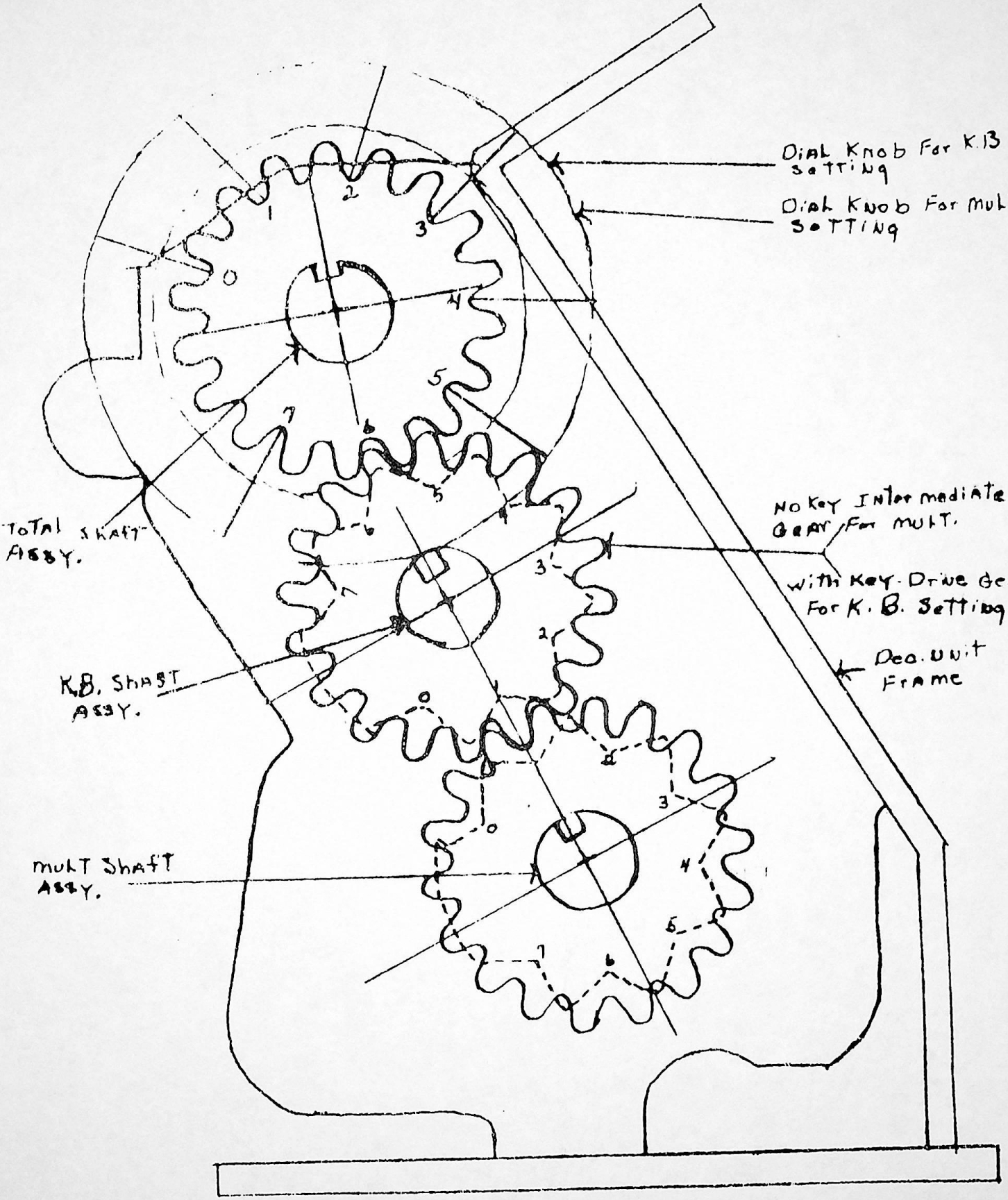
1. Remove the carriage (optional).
2. Remove the left control K.B.
3. Remove the set-up carriage and square plate.
4. Remove the set-up clutch locater and escapement cam follower.
5. Remove ribbon
6. Remove the ribbon reversing lever and space pawl assemblies. on each side & ribbon raising links.
7. Remove 2 cable drums from the R.H. end of the decimal shafts.
8. Un-hook the long spring attached to upper decimal selecting slide.
9. Remove a short screw from below the decimal unit on the R.H. side.
10. Remove a screw and lock washer from the decimal unit located below the R.H. ribbon post.
11. Remove a screw and lock washer from the decimal unit located on the left side of the print unit.
12. Remove 2 screws and 2 lock washers tieing the L.H. front side of the decimal unit.
13. Remove a short screw from below the decimal unit on the L.H. side.
14. Remove a tru-arc and disconnect the link from the decimal bail.
15. Remove the lock to the multiplicand clutch: 1 screw, washer and collar, gravity lock.
16. Remove the decimal belt from the rear pulley.
17. Remove the cable pulley from the L.H. side of the decimal unit.
18. Remove set-up carriage return cable from rear positioning plate.
19. Remove the decimal unit.

To replace the unit, reverse the above procedure.


"C"
Sun Gear
Planet Gear
"B"
Crown Gear
"A"
Rt. End Frame
Dec. Unit Frame
Mult. Shaft

Timing - Dial Knobs For Decimal Setting

1 - 1


Dial Knob For K.B setting
Dial Knob For Mult. Setting
No Key Intermediate Gear For Mult.
with Key Drive Gear For K. B. Setting
Dec. Unit Frame
Total Shaft Assy.
K.B. Shaft Assy.
Mult Shaft Assy.

To remove the upper hammer unit:

1. Remove the carriage.

2. Remove the ribbon guide mechanism on each side (2 tru-arcs each).

3. Remove the ribbon space and reverse mechanism on each side. (1 tru-arc reverse lever, spring, spacer, and space pawl and leaf spring).

4. Remove a screw and lock washer on each side of the unit.

5. Remove a hex stud and star lock washer on each side of the unit.

6. Remove a tru-arc from L.H. drive link, disconnect the link and move the link forward.

   Link for operating hammer restore and release bail.

7. Remove a tru-arc from the R.H. drive link, disconnect and move the link forward.

8. Remove a tru-arc from the ribbon raising mechanism on the R.H. side, disconnect and move the link forward.

9. Insert a wire thru the type wheels to hold type wheels at "0".

10. Remove the top hammer guide (2 short screws and 2 lock washers).

11. Rock the hammer unit up and rearward. Do not allow the unit to move up at its rear until the hammer firing bail is in the clear.

12. Rotate the unit counter-clockwise to remove.

To replace the hammer unit:

1. Reverse the above procedure.

Caution: Hammer tails go to the left of their respective racks.

Caution: The short screws that hold the upper hammer guide in place must not bottom on the hammer firing bail or interfear with the hammer firing bail section.

Caution: Be careful not to bend decimal print slides as they will bind & print when not called for, also top hammer guide will cause same problem if not zoned properly.

To remove the Printing Unit and Front Rack assembly:

1. Remove all key boards and K.B. interlock.

2. Remove the set-up carriage and the square plate.

3. Remove the carriage.

4. Manually release the main machine clutch and cycle the machine until the racks are fully rearward (stop before alignment).

5. Un-hook 3 springs from the rear spring anchor bar.

6. Remove all rack springs and the spring anchor bar.

7. Remove the rack restoring cam follower springs on both sides and the tru-arcs at the cam follower upper end. Disconnect the links.

8. Remove the hex guide screw and lock washer from the R.H. side of the rack guide plate.

9. Remove the screw and lock washer on L.H. side of the rack guide plate.

10. Remove the rack guide plate.

11. Un-hook the racks.

12. Remove screw and nut that passes thru the escapement lever and detent arm for the set-up clutch and remove these parts. Unhook spring from detent arm.

13. Un-hook the large spring inside the R.H. side frame that passes over the R.H. end of the rear tie rod.

14. Un-hook the spring that passes over the L.H. rear tie rod.

15. Remove the decimal belt from the back pulley. Old style

16. Remove the space bail (2 springs, 2 tru-arcs & 1 washer).

17. Remove shaft & bail below & to rear of space bail. (1-spring & 3-tru-arcs)

18. Remove the division tab hold up mechanism: (Watch for spring on hold-up link) (garbage shaft)

    a. Un-hook 2 springs, remove all tru-arcs from small diameter shaft near the top and left rear of the machine.

    b. Move the shaft to the left, remove the small collar.

    c. Move the shaft up and to the right and remove the assembly on the shaft.

Remove Printing unit and front rack assy (page 2):

19. Remove the selector position arm thru the back of the machine and un-hook 1 spring & 1 tru-arc.

20. Remove the enter selector lock (1 screw, 1 washer, 1 spacer). Gravity latch. [illegible]

21. Loosen the set screw in a collar just over the transmission. Hold up latch shaft.

22. Remove 2 tru-arcs from the clutch reset arm and the clutch latch area so these parts can move away from the side frame.

23. Un-hook the set-up carriage return cable from the rear positioning plate.

24. Un-hook the spring from the cable drum. On stud inside - side frame

25. Remove the Total-sub-total lever and toggle spring.

26. Remove 3 tru-arcs and disconnect the links to:

    a. Multiplier bail.

    b. Multiplicand bail.

    c. Decimal bail.

27. Remove 1 screw and lock washer from the front L.H. corner of the set-up carriage area. Out side of left side frame.

28. Remove 2 5/16" hex nuts and 2 star lock washers on each side near the top rear of the print unit.

29. Loosen 2 screws below the above nuts.

30. Pivot the 2 arms just loosened up and forward.

31. Remove a large tru-arc from the left side of the racks on the front tie rod.

32. Remove 4 large screws and lock washers from the front and rear tie rods.

33. Racks must be rearward before lifting unit. Lift the trap door to move the symbol racks rearward.

34. Strain the left side frame left, lift the unit up on the right hand side and slip the front tie rod out.

35. Work the unit out.

When replacing the printing unit and front rack section:

1. Cycle the machine to about the 180° point.

2. Install the unit straight in, then lift the R.H. side of the unit and install the front tie rod.

Watch for:

1. Make sure spring & retainer for selector positioning link is on outside of side frame.

2. Link to the decimal bail may be out of place.

3. Couple decimal caming bail to operating bail.

4. The Capacity locks.

5. Non-print lever.

6. Decimal control bail.

7. Red print control arm goes to front of cam follower shaft.

8. Make sure set-up carriage engaging arm is to the rear of rear tie rod.

9. Reverse the tear down procedure.

10. Make sure long side of front tie rod is to left.

11. Make the decimal selecting slide adjustment before hooking up the racks.

To re-time the decimal belt:

1. With both decimal indicators at "0".

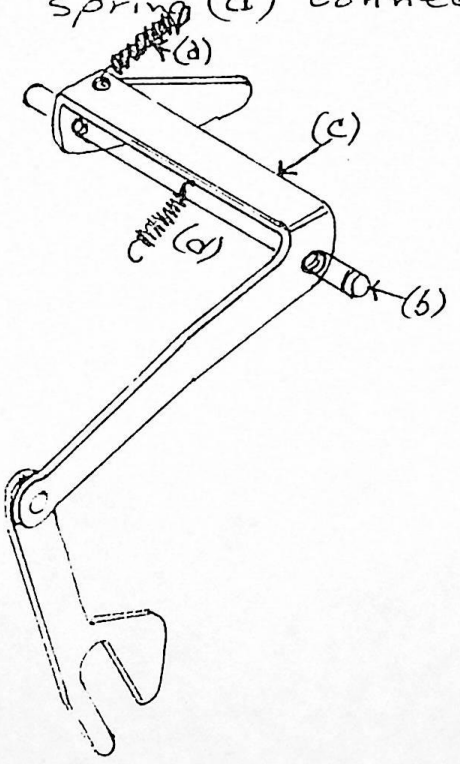
2. Time the belt so that the offset on the rear gear holds the off-set arm raised and so that when the L.H. decimal indicator is turned to 1, the rear gear allows the off-set arm to lower.

To Remove High Speed Clutch Unit

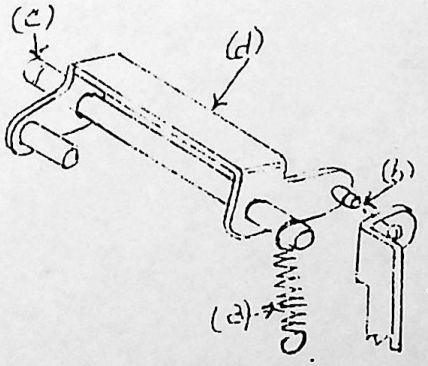
1. Remove Carriage & motor Unit.

2. Remove the drive pawl for the switch closing cam & remove drive belt from drive gear & idler pulley.

3. (A) Disconnect spring (a) from rack spring plate.
   (B) Remove 3 tru-arcs from shaft (b) & remove shaft.
   (C) Remove bail (c) from machine.
   (D) Leave spring (d) connected to the link in machine.



4. (A) Remove spring (a) from machine
   (B) Disconnect link from stud (b), 1 Tru-arc
   (C) Remove shaft (c) from machine.
   (D) Remove bail (d) from machine.



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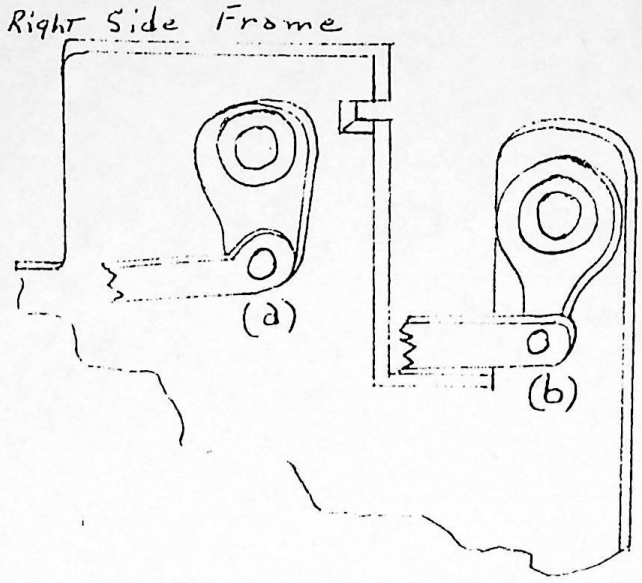
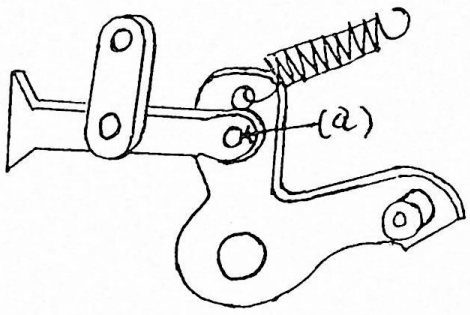
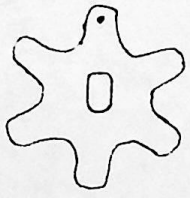


A. Remove Tru-ares from (a) + (b) + disconnect links.



5. Remove tru-arc from stud (a) + disconnect link.

6. Remove the star wheel.



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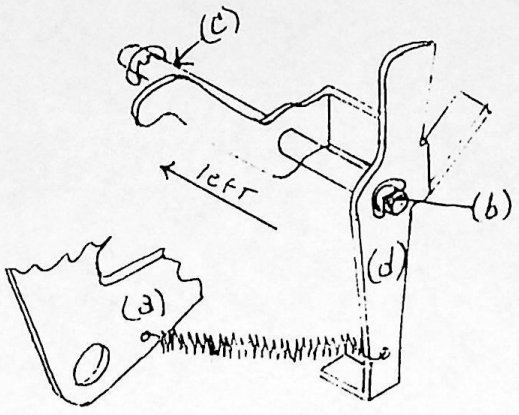
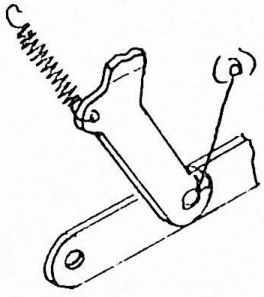
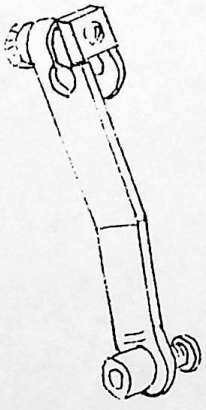


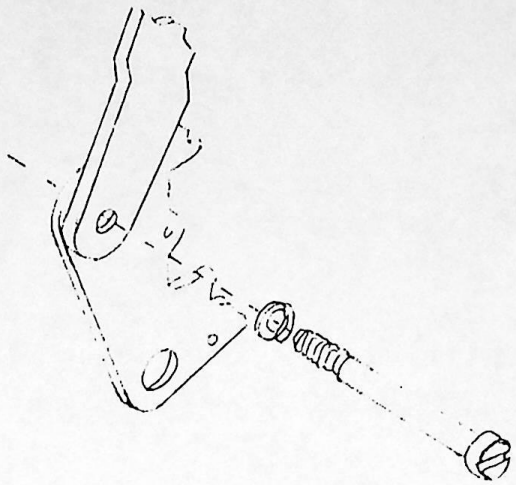
A. Disconnect spring from hole (a).
B. Remove tru-arc (b) + remove shaft (c) to the left.
C. Remove bail (d) from the machine.



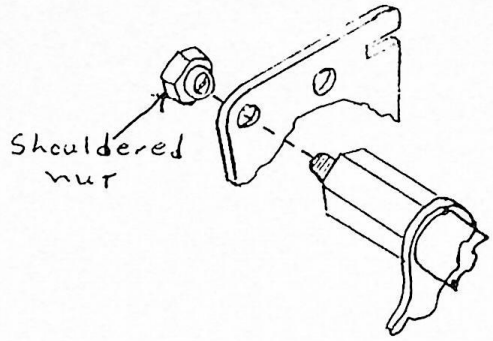
8. Remove tru-arc at (a) + disconnect link.



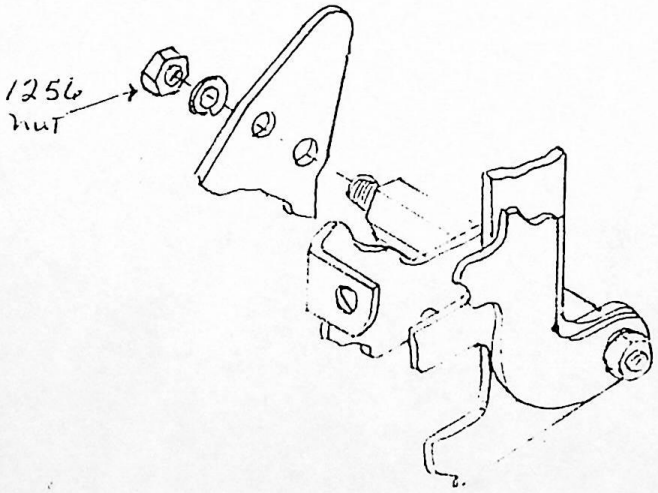
9. Loosen clamp arm. (It may or may not be removed at this time).



10. Remove the long screw + lock washer from the front of the unit.



11. Remove the shouldered nut from the top left hand side of the unit.



12. Remove the 1256 nut + lock washer from lower rear, left hand side of unit.

13. Work the unit to the right & off of the machine, & if not removed previously, remove the clamp arm at the same time the unit is being removed.

NOTE: Be careful when working the unit off as the selector shift control slide must be worked free of the "fish tail".

NOTE! Be careful not to loose the shift ratchet gears, the collar on high speed shift clutch shaft, & the selector drive coupler.

Installing The High Speed Clutch Unit

1. Use small keyed shaft to hold the two ratchet gears in place while installing the unit.

2. Turn the selector with the setable teeth to the rear & install the drive coupling on right side in proper position.

3. Place the shift clutch coupling in place on the shift shaft

4. Check that both clutches are in neutral before coupling them to there mechanisms.

5. Start working the unit on & engage the fish tail with the shift control slide

6. Make sure the roller on the plus & minus shaft is in front of the short cut toggle arm, & that the short cut shift bail engages with the stud at the top of the toggle arm.

7. Time the carry drive gear as the unit is installed, small protrusion opposite the wedge unit roller arm.

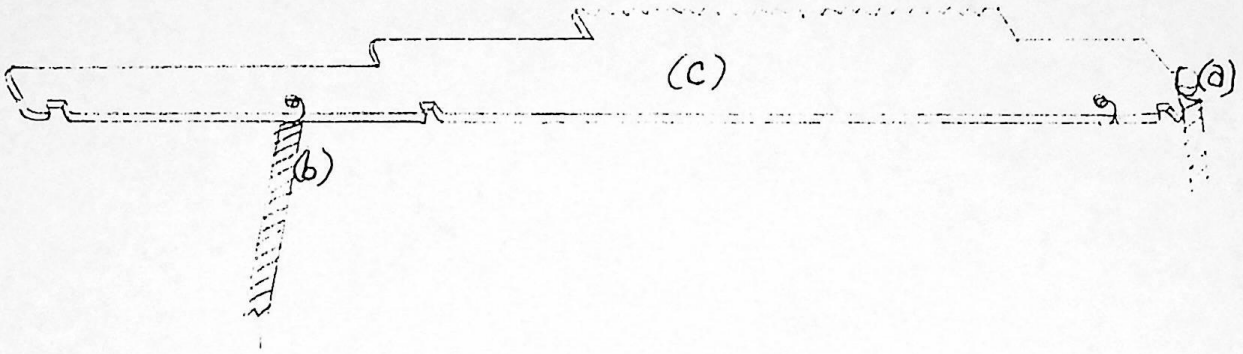
8. Secure with long screw & nuts & then check that everything is properly assembled before proceeding.

9. On old style the 2 lamp arm can be installed after the unit is installed.

With The High Speed Unit Removed

Remove Selector & M/Q Unit

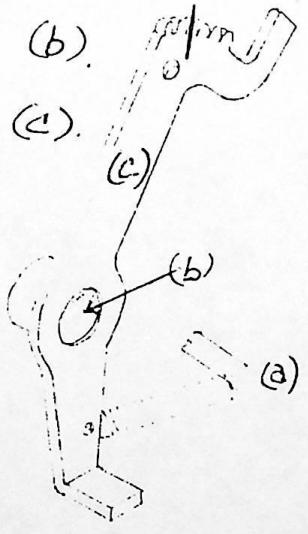
I



1. Unhook spring (a) from spring anchor.
2. Unhook spring (b) from spring anchor.
3. Remove spring anchor bar (c) & all rack springs.

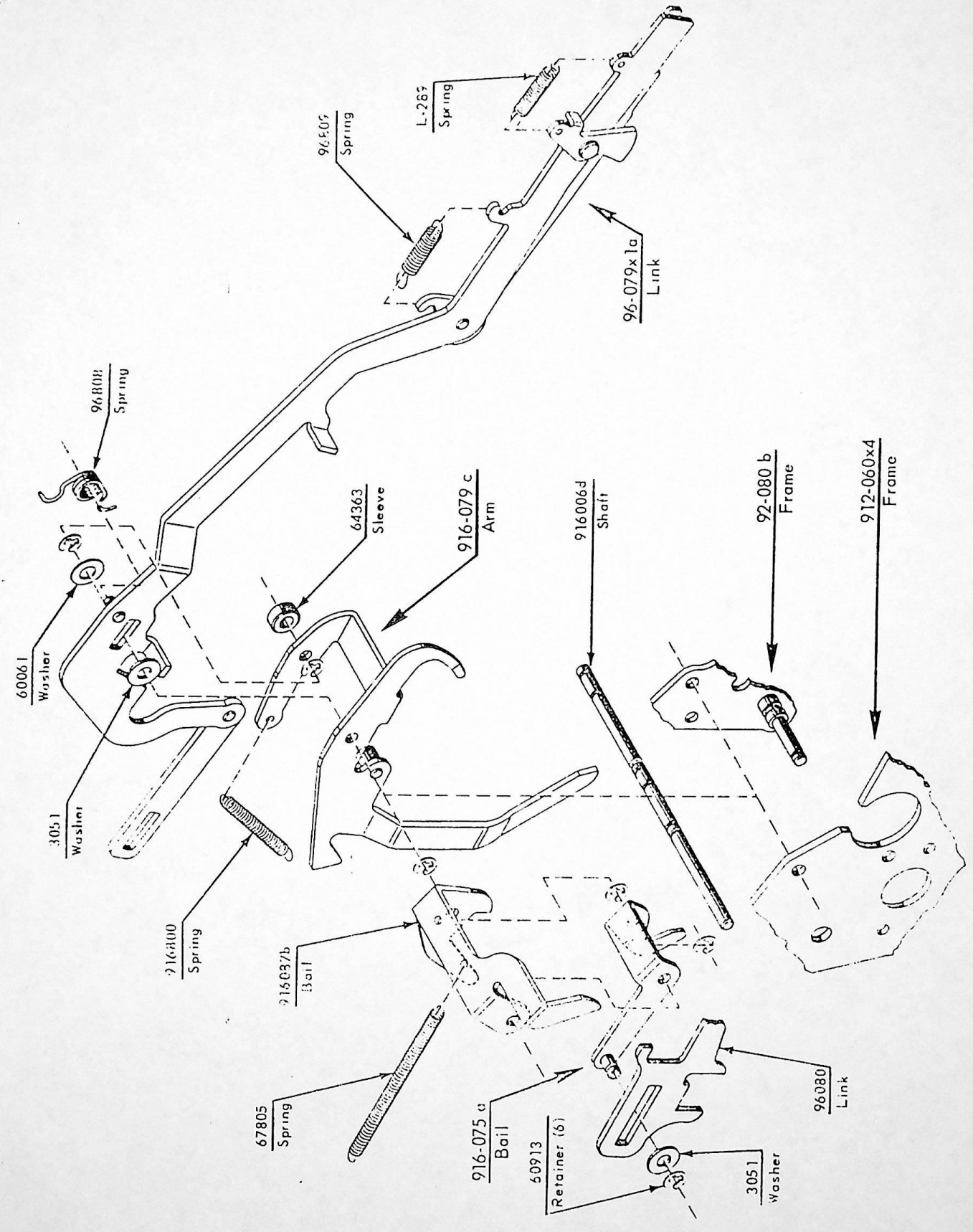
II Remove the mult. hold up linkage (Garbage Shaft) Ref: next page
Remove shaft & division Trip Cam latch.

III. 1. Unhook spring from stud (a).
2. Remove Tru-arc at (b).
3. Remove segment (c).



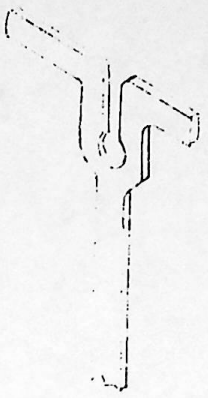
Retime with the keyway above the 3rd tooth on the segment.

Garbage Shaft



4. Remove The "T" arm & Mult. starting bail.

Watch for Toggle spring on blocking link.



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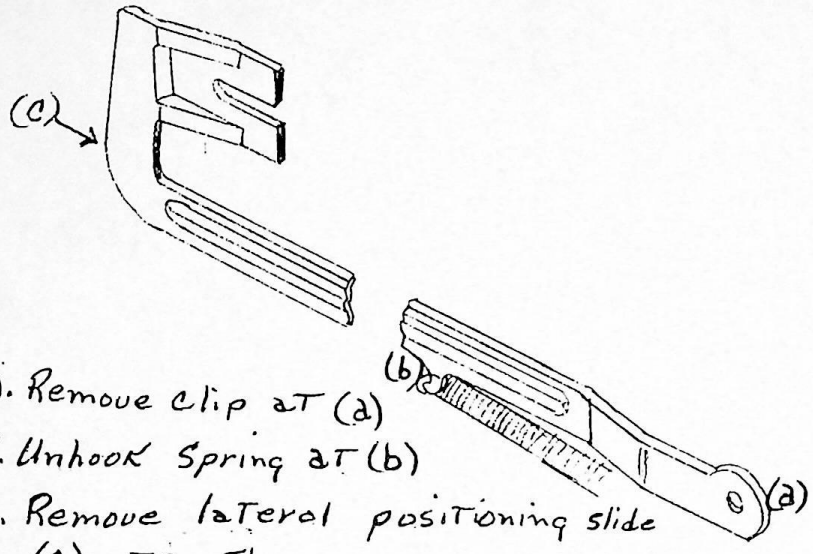
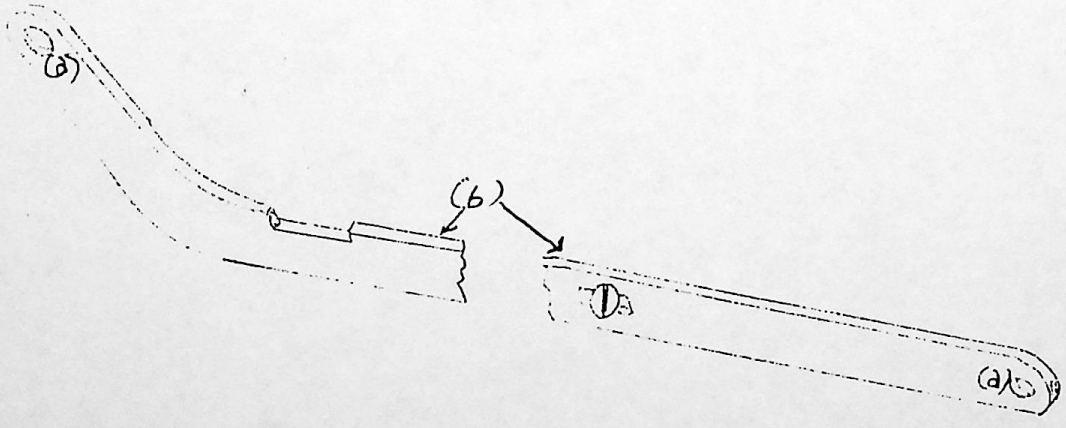


A. Remove clip at (d)
B. Unhook Spring at (b)
C. Remove lateral positioning slide (c) TO The rear

6. Remove clips at (d) & Remove The selector raising & lowering link (b)



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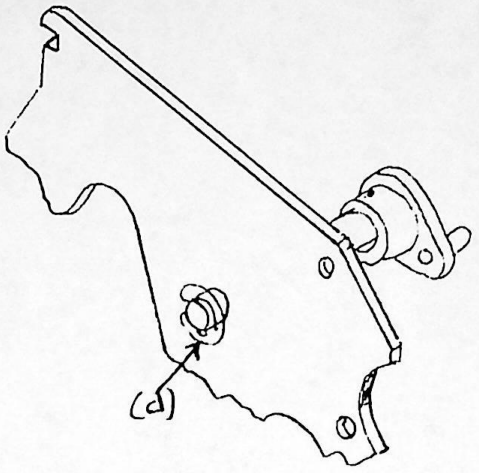
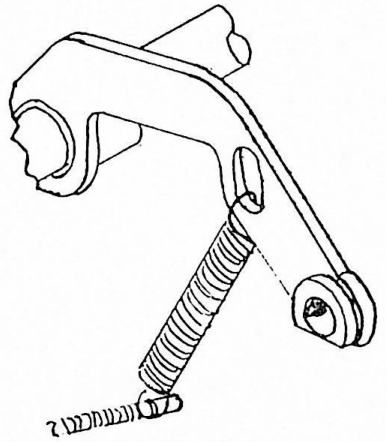


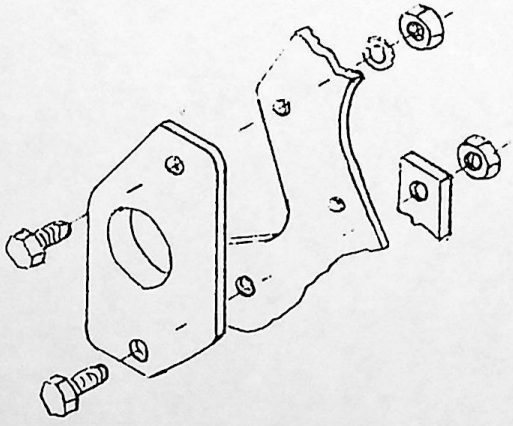
Remove the tru-arc from left hand end of the division starting & decimal transfer shaft (a). The shaft will come out of the side frame as part of the unit.

8.



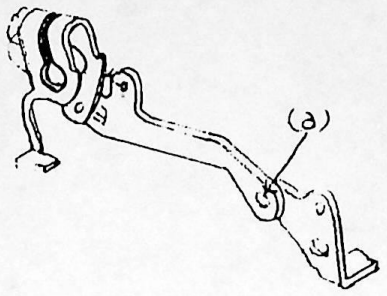
Unhook the left hand selector control arm spring from screw stud.

9

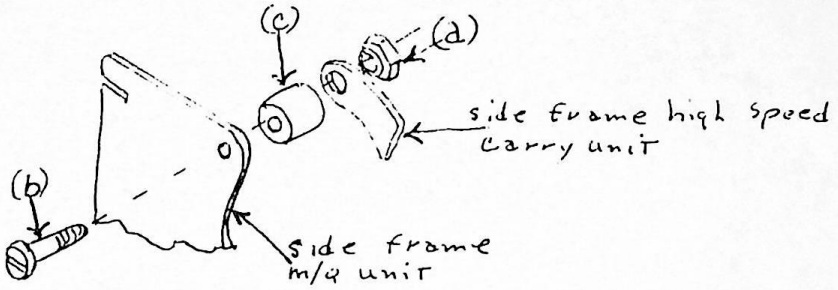


Remove two hex screws & nuts from the rear left hand support bracket for the selector control shaft.

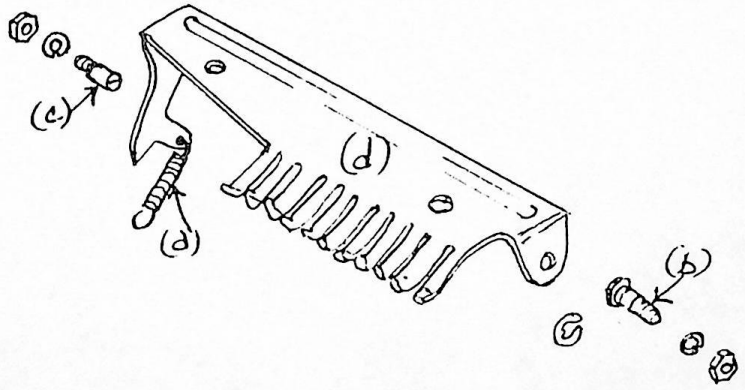
10.



Remove the Tru-arc at (a) + disconnect the push/pull link.



11. Remove the shouldered nut (a), screw (b) + collar (c) from the upper left hand side frame of unit.



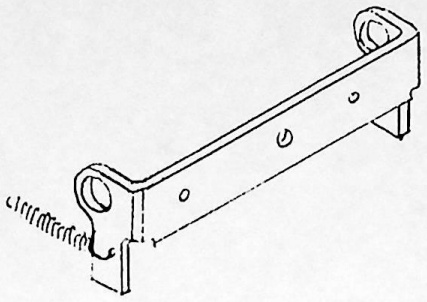
12. Unhook spring (a) from stud.

Remove Tru-arc from screw (b) + remove nut + lock washer + screw.

Remove nut + lock washer from pivot stud (c) + remove stud.

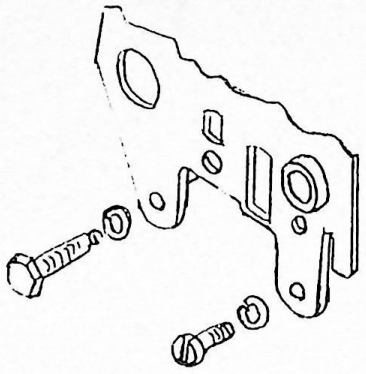
Remove bail (d)

13.



Unhook the M/G zero bail spring from its stud.

14.



Remove the two screws + lock washers on the left & Right sides of the M/G unit, holding the unit to the rear rack side frames.

NOTE: The rear left hand screw has a hex head & is the spring anchor stud for the M/G zero bail.

15. Remove the unit.

To Replace The Selector + M/Q Unit.

1. Selector carriage slot should engage with left leg of the right hand sensing shoe. X

2. M/Q gear zero bail goes to the front of the square bar. X

3. Plus/minus shaft roller arm goes above roller on left end of shaft. Square cam shaft.

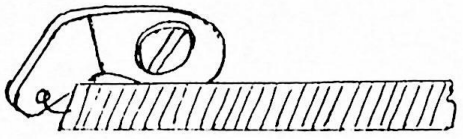
4. Shift control slides should have their right hand lugs between side frame & selector carriage. X

5. Couple the division starting shaft to the shift tab shaft. X

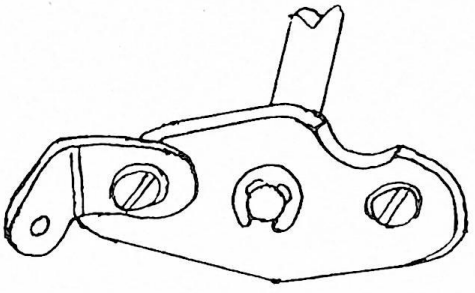
6. Keep the selector raising flowering shaft bearing plate to the outside of the side frame. X

To Remove The High Speed Carry Unit

1. Remove the high speed clutch unit.
2. Remove the selector and M/O unit.
3. Unhook the set-up carriage spring from its rear anchor.

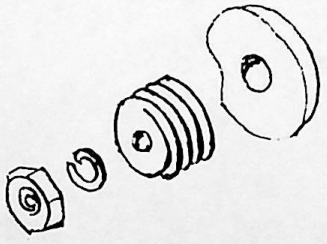


4. Remove two screws, lock washers & 1 spring anchor from bearing for selector clear shaft & remove the selector clearout shaft to the left.



NOTE: It may be necessary to unhook the left hand spring from the wedge restoring bail before attempting to pull the selector clear out shaft, as it may interfer.

5. Remove the O-O transfer bail transport screw & bearing.



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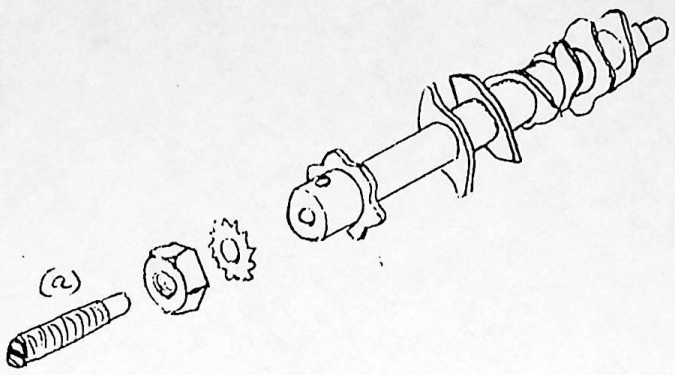
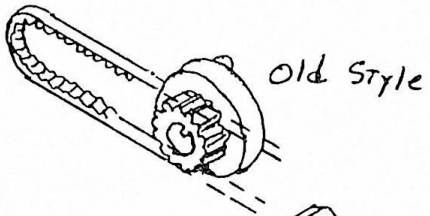
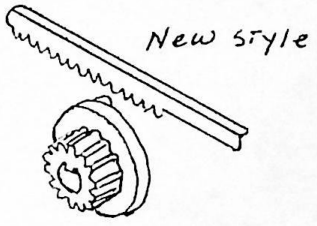


Remove screw (a) from the left hand side frame and remove the division sequence cam shaft.

7. On old style machines slip the decimal drive belt off of the rear gear.

On new style machines remove the rack.





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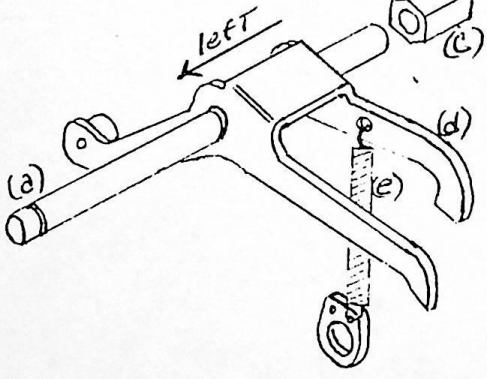
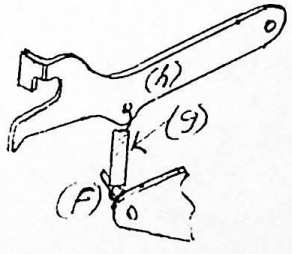




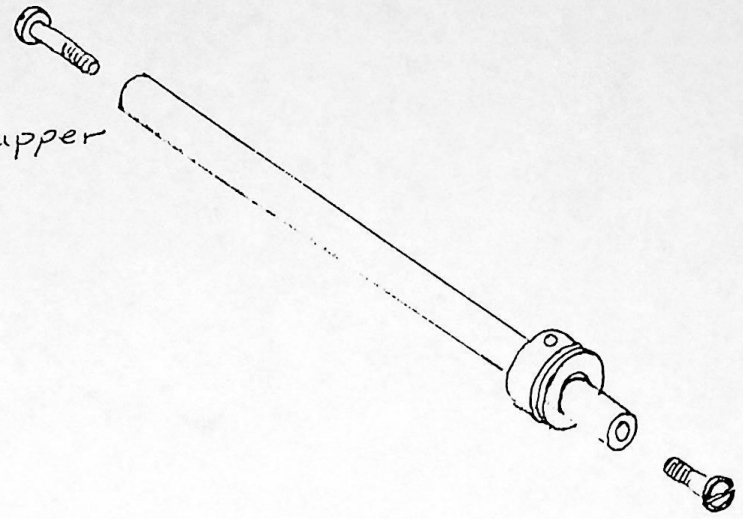
A. Remove the Tru-arc from left hand end of shaft (a).

B. Unhook spring (e) from holding pawl (d).

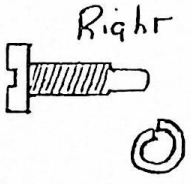
C. Unhook spring (g) from stud (f).

D. Disengage feed pawl (h) from holding pawl (d) & move shaft (a) to the left out of her bearing stud (c) & leave shaft (a) in the machine.

10. Remove the upper Tie rod



11. Remove the right & left register limit screws from the rear rack side frames. The left screw has a shaft retainer under it, & the right screw has a lock washer

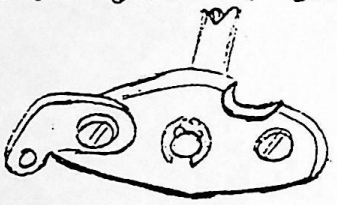


12. Remove the unit from the machine.

High Speed Carry Unit

1. Remove the High Speed Clutch Unit.
2. Remove the Selector and M/Q Unit.
3. Unhook the set-up carrying spring from its rear anchor.

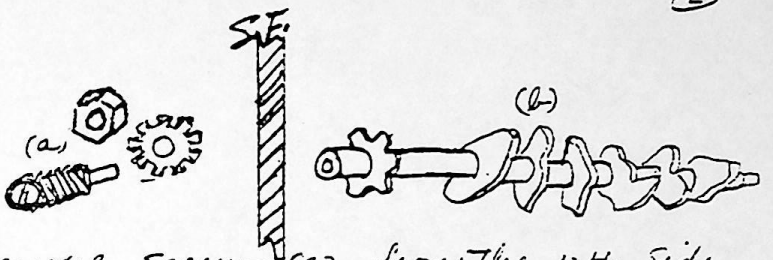
4. Remove the L.H. bearing for the Selector Clear-out Shaft from the S.F. and remove the Selector Clear-out Shaft.



NOTE: It may be necessary to unhook the L.H. spring from the wedge reset bail before attempting to pull the selector clear-out shaft to the left as it may interfere with the L.H. clear out gear.

5. Remove the 0-0 Transfer transport bail screw and bearing

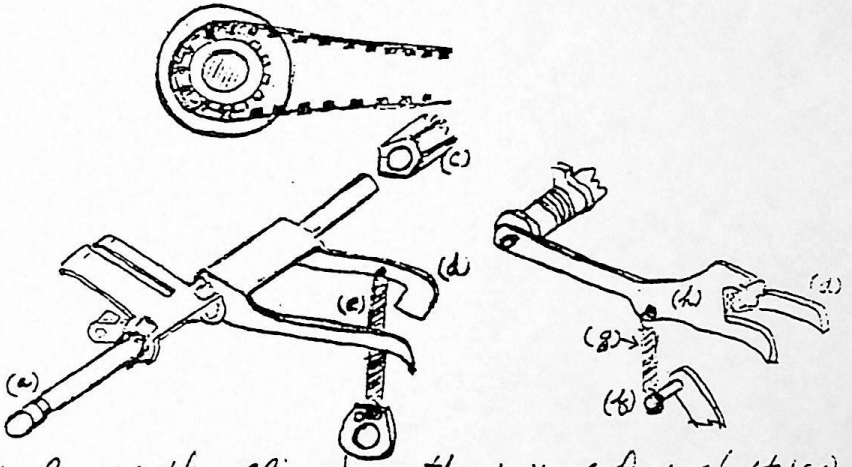
6.



Remove screw (a) from the L.H. side frame the sequence cam shaft (b) can be removed now or left in and removed with the unit.

7. Slip the ~~Main~~ selector drive belt off at the rear.

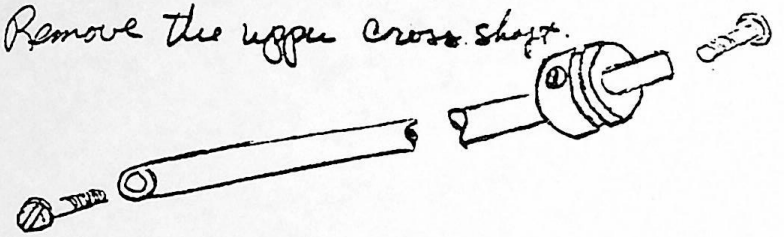
8.



1. Remove the clip from the L.H. end of shaft (a).
2. Unhook spring (e) from holding pawl (d).
3. Unhook spring (g) at (f)
4. Disengage the disc cam cam pawl (h) from the hold pawl (d) and move shaft (a) to the left out of

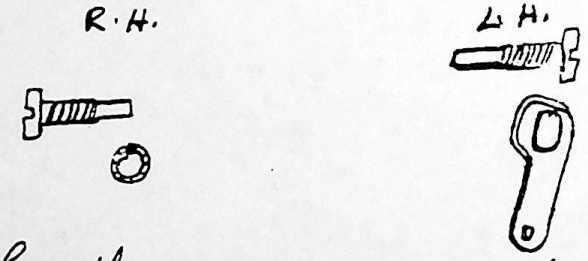
its bearing (c) Leave shaft (a) in the machine until the unit has been removed.

9. Remove the upper cross shaft.



10. Unhook the interposer springs from the interposers.

11. Remove the R.H. and L.H. register link screws from the rear rack side frames.
NOTE: The L.H. screw has a shaft retainer under it and the R.H. screw has a lock washer.

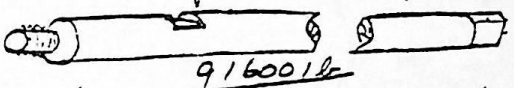


12. Lift the unit out of machine -

NOTE:

Before Installing the High Speed Carry Unit check the following:

1. Check the timing of the 21st carry gear.
2. Place the L.H. end of shaft (a) (Item #8) between the sequence cam shaft detent arms and into its bearing hole in the side frame.
3. Place the L.H. end of the 916001 Shaft between the sequence shaft detent arms



and through its bearing hole in the side frame
4. Check that the forward extension on the R.H. end of the weight restoring bail positions under the black stud.
5. Check that all interposer fingers enter the slots of the interposers.
6. The sequence cam shaft can be installed after the unit is in place.

Before Installing the High Speed Carry Unit
Check the following.

1. Check the Timing of the 21ST Carry gear.

2. Place the left hand end of shaft (a) (Item #8) between the Sequence Cam Shaft detent arms & into its bearing hole in the side frame.

3. Place the left hand end of the shift shaft between the sequence cam shaft detent arms & through its bearing hole in the side frome.

4. Check that the forward extension on the right end of the wedge restoring bail positions under the black screw stud.

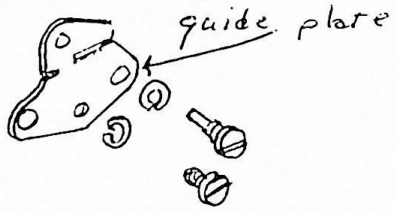
5. Check that all interposer fingers enter the slots of the interposers.

6. The sequence cam shaft can be installed after the unit is in place.

To Remove The Wedge Unit

1. Remove the high speed clutch unit.

2. Remove two screws & lock washers from wedge unit guide plate & remove the guide plate.



3. Remove the wedge unit to the right & remove compression spring on left end.

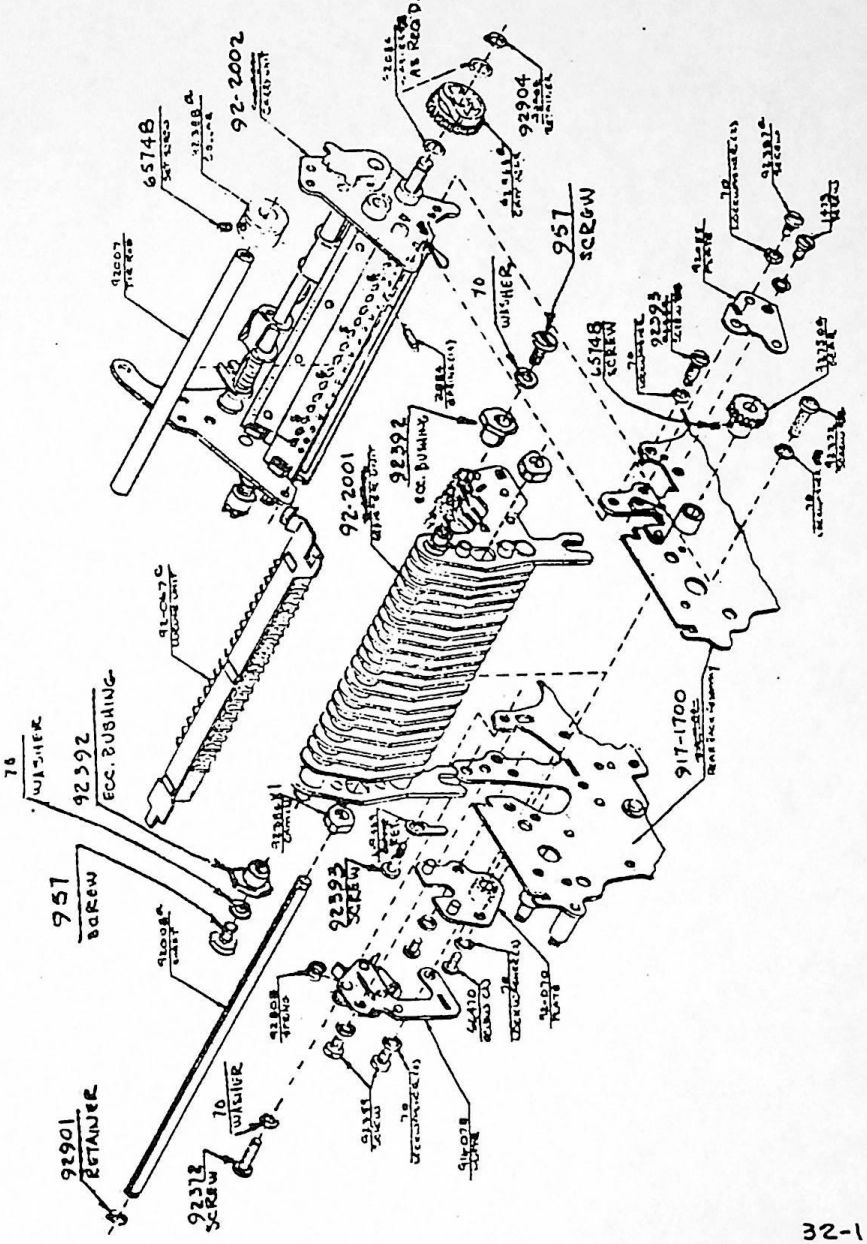
Remove Wedge Unit # 92-067c

1. Remove the High Speed clutch units.
2. Remove screws 92387a and 1473 from the 92055 plate. (Page 32-1 attached)
3. Remove the 92055 plate and wedge unit out to the right.

Remove the Register Unit # 92-2001

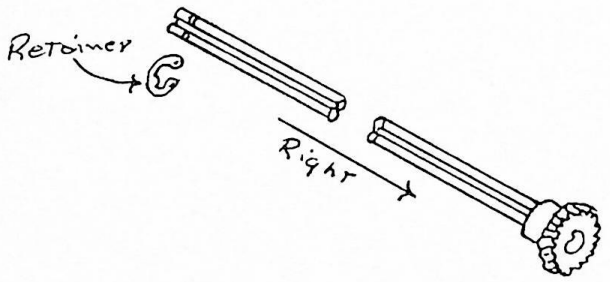
1. Remove the High Speed Clutch Unit
2. Remove the Selector and M/Q Unit
3. Remove the High Speed Carry unit
4. Remove the Wedge Unit
5. Remove shaft 92901 (page 32-1 attached)
6. Remove eccentrics 92392 (page 32-1 attached)
7. Lift the Register Unit up and out of the machine.

NOTE: Before installing make sure screws 92384X1 are correctly located.



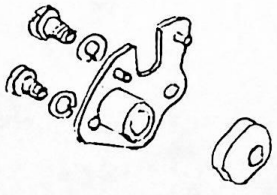
To Remove The Register Unit

1. Remove the high speed clutch unit.
2. Remove the selector & m/q unit.
3. Remove the high speed carry unit.
4. Remove the wedge unit.
5. Remove the small retainer on the left end of the register positioning shaft, & remove the shaft to the right.



6. Remove right hand positioning cam.

7. Remove two screws & lock washers from left bearing & plate & remove the plate & left positioning cam.



8. Remove two hex screws & lock washers at top of left & right side of unit & remove the eccentrics.
9. Remove the register unit.

HIGHLIGHTED FAILURE AREAS WITH SERVICE CORRECTION
OR PARTS IMPROVEMENT FROM QUALITY ASSURANCE ANALYSIS SHEETS

March 8, 196

CATEGORY #1 - "SETUP CARRIAGE"

ITEM #1 - Setup Carriage Detent Springs Breaking

(A) Change in spring - New spring 91800c in production

ITEM #3 - Setup Carriage Improperly Zoned Sidewise with Racks

(A) Shim decimal stops

ITEM #6 - Setup Clutch Not Releasing on Slow Depression of Numeral Key

(A) Adjust clutch release link eccentric

(B) Form 910-054x2 link to move 910052x1 single cycle latch clear of clutch pawl.

CATEGORY #2 - "Register - Selector - Wedge and Carry Unit"

ITEMS #1 & #2 - Selector alignment off - Cannot balance for mult. and Div.

(A) Loose teeth in selector
(B) Radially off selector teeth } Replace selector
New selector design to be released

ITEM #3 - Wrong Product Totals - Register Eccentric Adjustments

(A) .004 - .006 Register play adjustment incorrect

(B) Change in register cams - to be in production soon

ITEM #4 - Broken Clearout Gears 92953A, 92954A

(A) Selector alignment when in clearout

(B) Hold-up not operating properly during transfer

(C) Critical hold-up adjustment usually 1 - 1 decimal transfer

ITEM #48 - Not Dividing Right - Miscalc -

(A) Improper or inadequate shimming of 92968A wedge box operating cam

(B) Selector alignment

CATEGORY #3 - "Ten Key Numeral Keyboard"

CATEGORY #4 - "Accumulator Section"

ITEM #1 - Not Clearing Accumulators - Readjust accumulator Adjusting Arm

(A) Neg. transfer to register

(B) Neg. position pin in left end of accumulators not fully positioning neg. flap

(C) Not getting full plus and minus selection drive

(D) Accumulator not neutralizing or not adjusted for neutral setting

ITEMS #3 & #4 - Replaced Accumulators 94-4001 (broken - bending)

(A) Accumulator plus and minus positioning cramped

(B) New accumulators are available - Material change.

ITEM #8 - Carryover Failure

(A) Carry bail eccentric adjustment

(B) Transitional carry latches not properly stacked for size

(C)

CATEGORY #5 - "Left and Right Control Keyboards"

ITEM #2 - Failing to Program for Transfer X

(A) Peen keystem front extension for less movement after latch with clutch release bail

(B) Improper program feed adjustment

CATEGORY #6 - "Add Clutch and Gear Box, Left Side Carriage Return and Hold-up Mechanism"

ITEM #1 - Adjust 96-056 arm Hold up extension

(A) Research change on this to eliminate misoperation cause of this in production.

(B)

ITEM #1c - Readjust Hold-up 96-079x1 - Booster spring - Hold-up latch

(A) Research change on this in production.

ITEM #3 - Hold-up Sluggish on Release

(A) Binds

ITEM #5 - Setup Carriage Failing to Restore

(A) New carriage return drum mechanism available

ITEM #8 - Readjust Single Cycle Latch 96062x1 - Failing on Fast Depression of Keys

(A) Adjust single cycle latch mechanism

ITEM #19 - Adjust Clutch Release Bell Crank 96073x1 Hold up & Release.

(A) Design change - brace added

(B) Eccentric on rear pully arm probable cause of bell crank collapse

(C)

ITEM #39 - Hold-up Link 96-079x1 Fails to Restore Sync Link

(A) Weak spring 96808

(B) Hold-up link binding

(C) No end play or bind in hold-up latch shaft 96-072x1B

CATEGORY #7 - "Auto Decimal Control Unit"

ITEM #1 - Wrong decimals printed - Readjust dec. control slide pulley

(A) New (white) dec. cord in production

ITEM #5 - Adjust Cable Drum 97367A

(A) New drum mechanism in production

ITEM #6 - Adjust Decimal Actuator

(A) Binds and misalignment

ITEM #7 - Replaced Broken 97-915B Cord

(A) Improved (white) cord

(B) Carriage return over adjusted

(C) Being frayed from a nearby part

ITEM #8 - Tab Belt out of Time

(A) Improved design rack replaces belt - reduces binds in dec. unit

(B) Close but incomplete adjustment causes improper decimal transfer

ITEM #16 - Replace broken 97-071 arm - Carriage Return Drum Clamp

(A) Improved design mechanism now available - in production.

ITEM #18 - 97-915B Cord off Return Rack 97-057 Rear Pinion Gear

(A) Over adjusted carriage return can cause this.

(B)

CATEGORY #8 - "Printing Unit Complete (upper-lower) and Ribbon Mounting Mechanism"

ITEM #3 - Adjust Ribbon Reverse Mechanism

(A) Design change available on ribbon control slide mechanism

ITEM #33 - Adjust Eccentric on Hammer Latch Raising Bail (98-113)

(A) Poor or fail to print

ITEM #47 - Bad Printing - Hammer Release Bail 98052 Not Latching

(A) Design change on hammer restoring bar

CATEGORY #9 - "Program Unit - Control Bails - Control Slides"

ITEM #1 - Adjusted Program Feed Plate

(A) Design change on feed plate drive bell crank

(B) Permanent center brace on cam follower shaft

(C)

ITEM #13 - Stripped Cam on 99-014A Mult. Program Cam Shaft

(A) Improved design and material 99-014c

ITEM #15 - Stripped Cam on 99-004x1B Div. Program Cam Shaft

(A) Improved design and material cam shaft

ITEM #16 - Broken Program Control Slide Restoring Spring 99800A

(A) Improved design spring 99800B

ITEM #21 - Transfer Not Opening 3 Cam Cluster

(A) Adjusted offset on 99181 slide for release of 3 cam cluster clutch pawl

ITEM #30 - Not Squaring at Times

(A) Change in design on 99-104 Repeat Bail

ITEM #61 - Replace Broken 99-104 Non Repeat Bail

(A) Change in design to eliminate spring tab - To be in Production soon.

ITEM #104 - Form Transfer Program Bail Symbol Lug - in Production

(A) Causes printing compliment on neg. transfer

CATEGORY #10 - "Right Side Mechanism - High Speed Setup Clutch and Switch"

ITEM #1 - Bad Switch Closing

(A) Switch adjustment - Lower contact blade not limiting on housing

(B) Change in design on 910-069x1C ratchet pawl - in Production

CATEGORY #11 - "Main Clutch Shaft Cam Followers"

ITEM #1 - Adjust main cam shaft with "S" gauge

(A) Design change - Permanent tie brace between cam followers and main cam shaft

ITEM #3 - Readjust Eccentric Roller Stud 911426A for Clutch Equalization

CATEGORY #12 - "Side Frames - Sub Frames - Base Plate - Cover Case and Packing"

NO HIGH FAILURES IN THIS CATEGORY #12

CATEGORY #13 - "Platen Unit and Paper Feed"

ITEM #3 - Incorrect paper spacing - increased tension on feed rollers

(A) Increased tension on feed rollers - L-283 spring replaces 1010 spring.

CATEGORY #14 - "Multiplier-Quotient Unit"

ITEM #1 - Mult. Sensing Fingers Binding

(A) Adjustment in .005-.010 clearance between mult. sensing bail and sensing fingers

ITEM #2 - Failing to Count Mult.-Quotient Gears

(A) Adjust 914-061 counting pawls

(B)

ITEM #28 - Collar L-7373 Coming Loose on 914008A Shaft Plus & Minus shaft.

CATEGORY #15 - "High Speed Control Unit"

ITEM #1 - Selector Not Returing Home on Decimal Transfer - Adjust 915-090 Arm Old Knowledge Issue

(A) Change in design - to be in production soon

ITEM #2 - Readjust Feed Pawl Eccentric 915-075x1A

(A) Uneven shifting of selector, causing poor adjustment of selector star wheel locator eccentric adjustment

ITEM #26 - Arm 916-083B Bent - Camming off Start Bail 915081 Weld & Cycle Detail Trip control Arm.

(A) Form for better hold

ITEM #44 - Div. Jam - Selector out One Position

(A) Scissor failing to close properly - New design 915-077B in production

(B) Weak clutch pawl spring

(C) #20 program slide not camming reset arm out of the path of the clutch pawl

(D) Lower offset on 96-058A reset arm contacting clutch pawl

CATEGORY #16 - "Division Mechanism & Tab Stop Mechanism for Division and Transfer"

ITEM #2 - Single Tooth 916-750A Gear Failing to Program Sequence Cam Shaft

(A) Form div. release arm for side alignment

(B) Proper end play of div. sequence cam shaft X

ITEM #17 - Stopping During Division

(A) Adjust shift cycle trip-link

(B) Binds in shift-cycle trip link

ITEM #19 - Readjust 916087, "0 Transfer Bail"

(A) Must enter worm freely

(B) Must release hold-up link when fully fed to end of worm gear

(C) "0 Bail" must release out of worm gear after being fed to end.

CATEGORY #17 - "Racks and Aligner Mechanism"

ITEM #1 - Front-Rear Racks Disengaged

(A) Possible broken clearout gear

(B) Hold-up problem

(C) Bind on rear racks by a control mechanism

ITEM #2 - Entering One Less Than Figure Entered into Setup Carriage

(A) Bind on rack ← Number roll too tight in set up carriage.

(B) Rack bounce ← Worn cam springs or time that rack aligners come in. Poss. Spacing adj.

CATEGORY #18 - "Motor and Mounting"

ITEM #2 - Adjust Speed

(A) 800 + - 6

CATEGORY #20 - "Operator Problems"

ITEM #2 - Operator Entering Two Figures into Register

ITEM #4 - Installed Paper Wrong

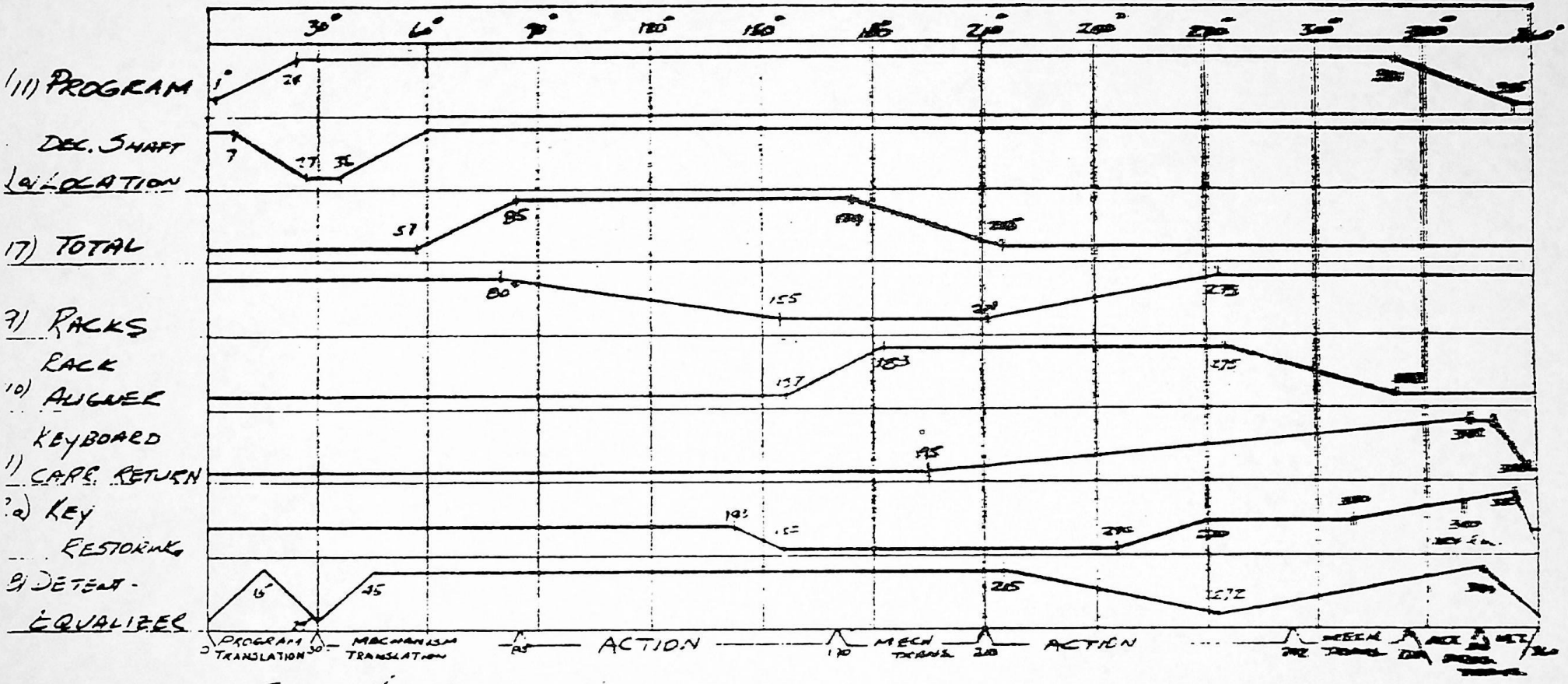
ITEM #18 - Instructed Operator on Setting Decimals

Martin Klijian, Jr.

JH 248
MGB

"CLEAR" FUNCTION

C

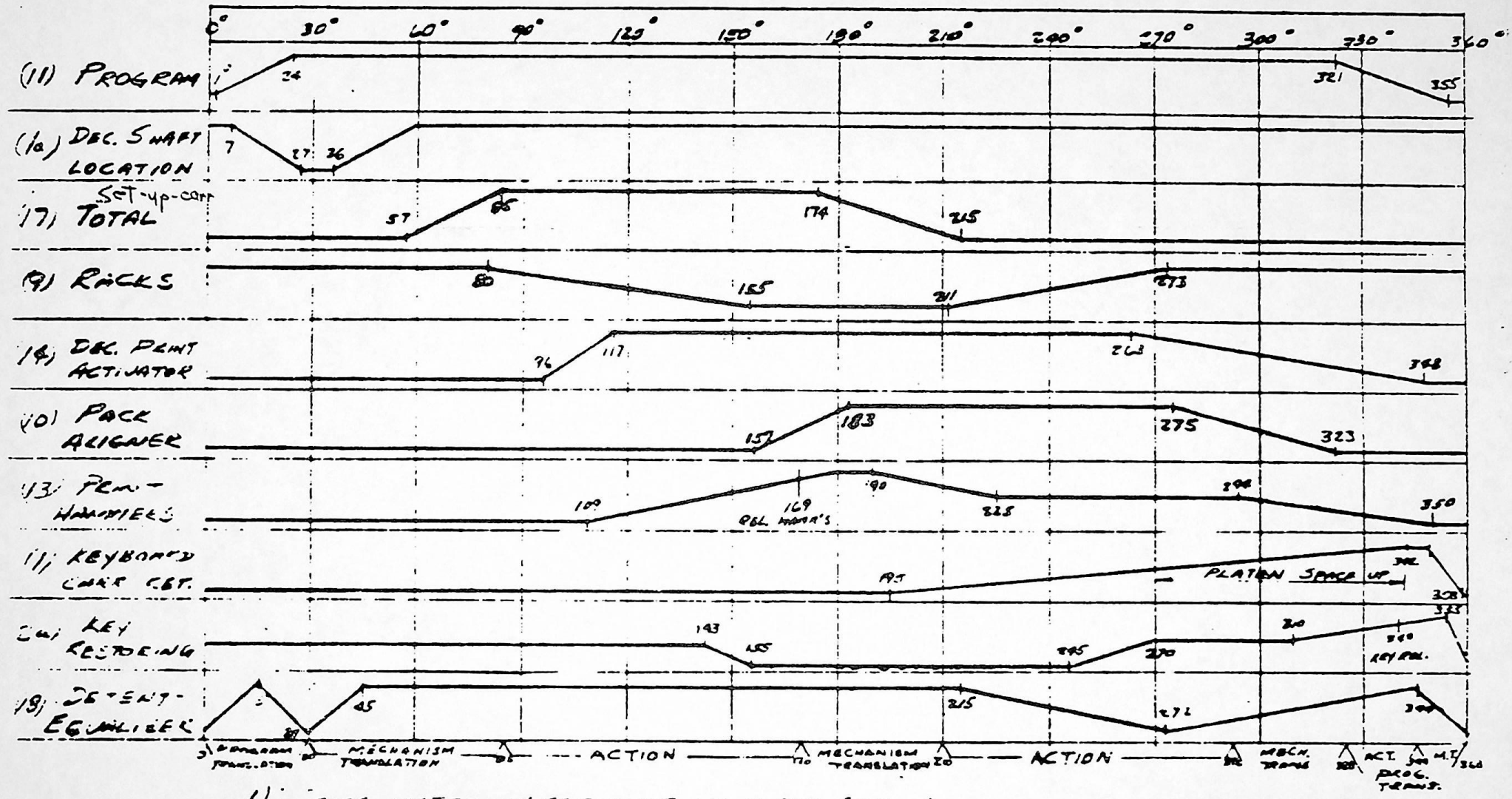


1.) CAMS LISTED IN SEQUENCE OF FIRST ACTION.

2) REF: "MAINSHAFT CAMS TIMING CHART 211 PC192" FOR NUMBERS SHOWN BESIDE CAMS

MTGGB
SH 2439

"NON-ADD" FUNCTION



1) CAMS LISTED IN SEQUENCE OF FIRST ACTION

2) REF: MAINSHAFT CAMS TIMING CHART 2 IN PCN 2 FOR NUMBER BESIDE CAMS

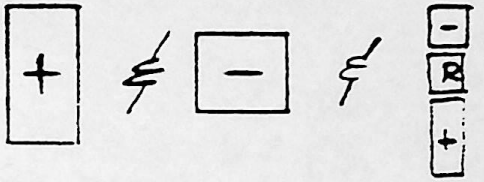
PCN: "NON-ADD"

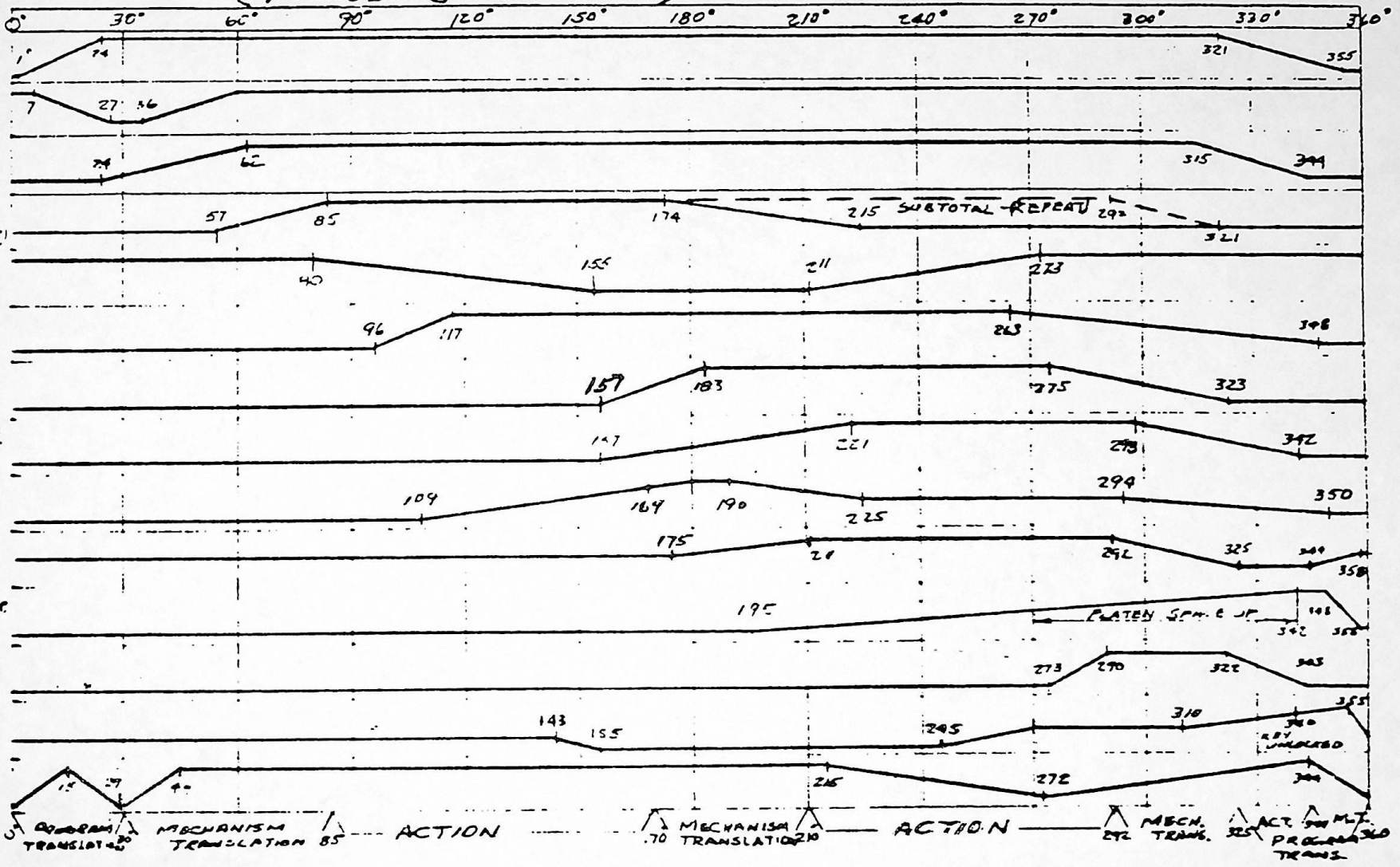
DVS 12-362

SH 2440
M-668

(19

"PLUS & "MINUS" FUNCTIONS
(INCLUDING "REPEAT")





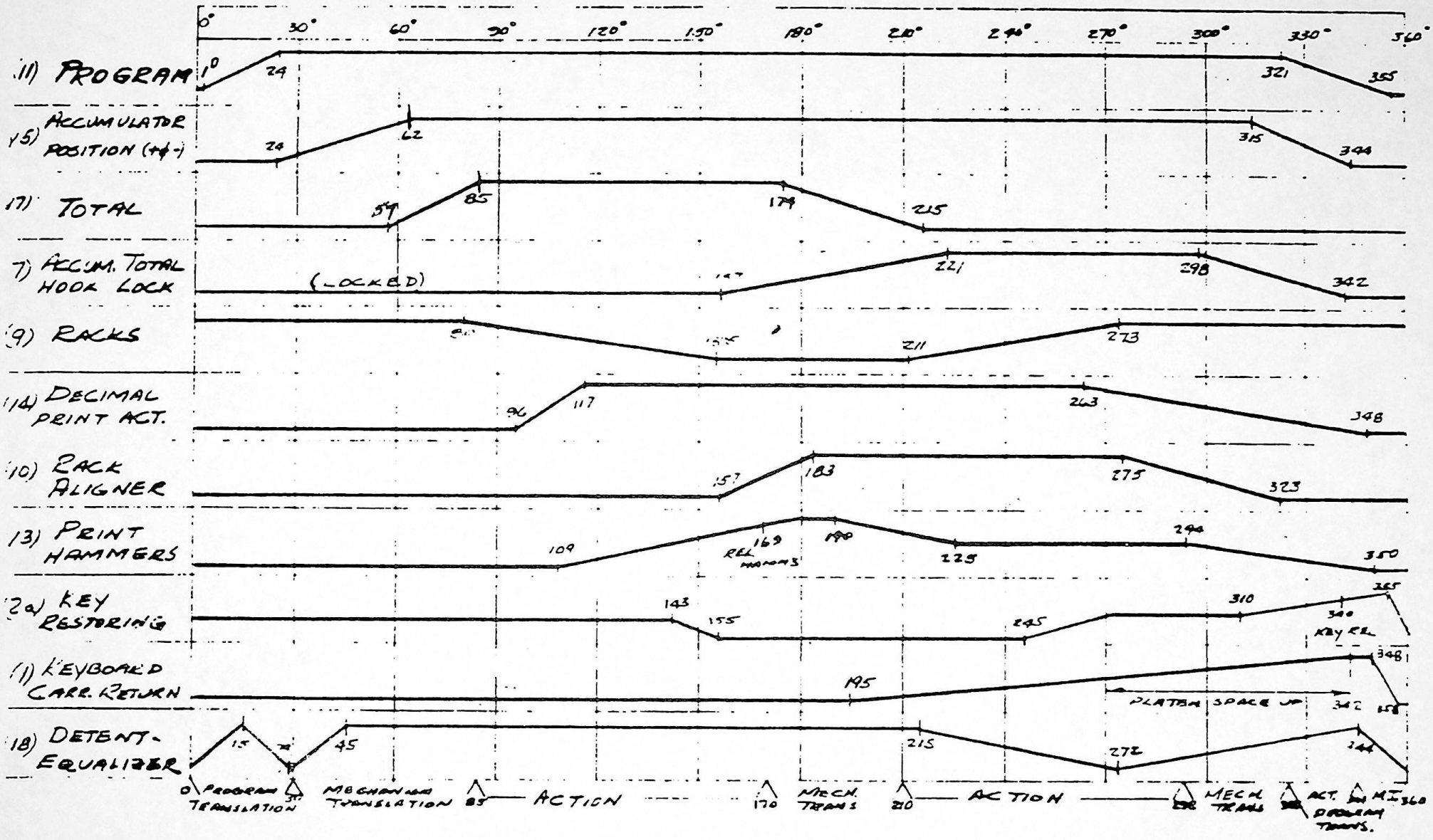
1) CAMS LISTED IN SEQUENCE OF FIRST ACTION.
2) REF: "MAINSHAFT CAMS TIMING CHART 211 PC 192 FOR NUMBERS BESIDE CAMS.
3) "REPEAT" FUNCTION SHOWN AS INTERRUPTED LINE FOR SUBTOTAL CAM

211 PC 192 "+ & −"

BWS 12-4-62

M-66
SH 2441

"TOTAL" FUNCTION



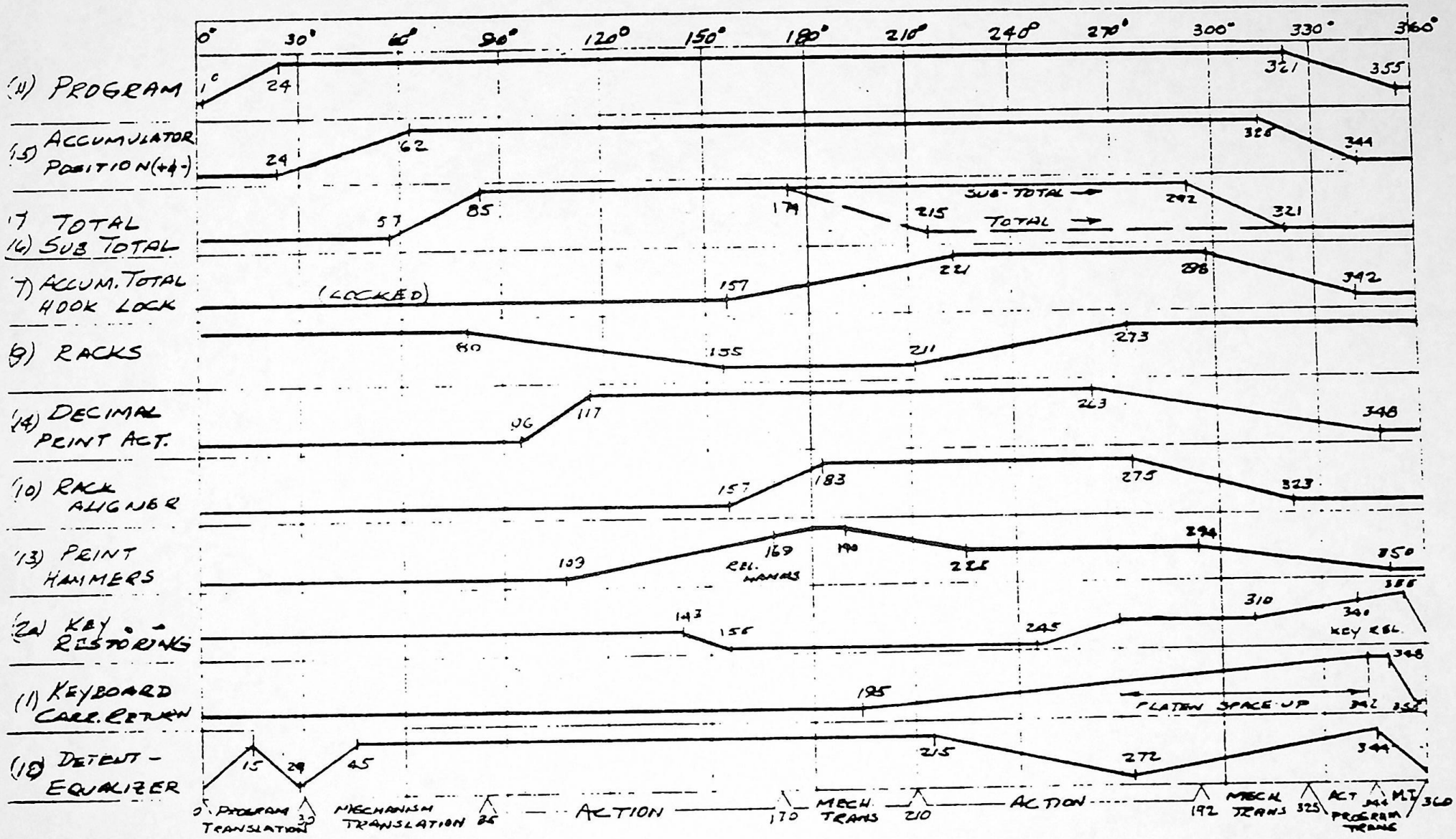
1.) CAMS LISTED IN SEQUENCE OF FIRST ACTION.
2.) REF: "MAINSHAFT CAMS TIMING CHART 211 PC 192" FOR NUMBERS BESIDE CAMS

211 PC 192 "TOTAL"

DMS 12-5-62

SN 2442
M 668

"SUBTOTAL" FUNCTION



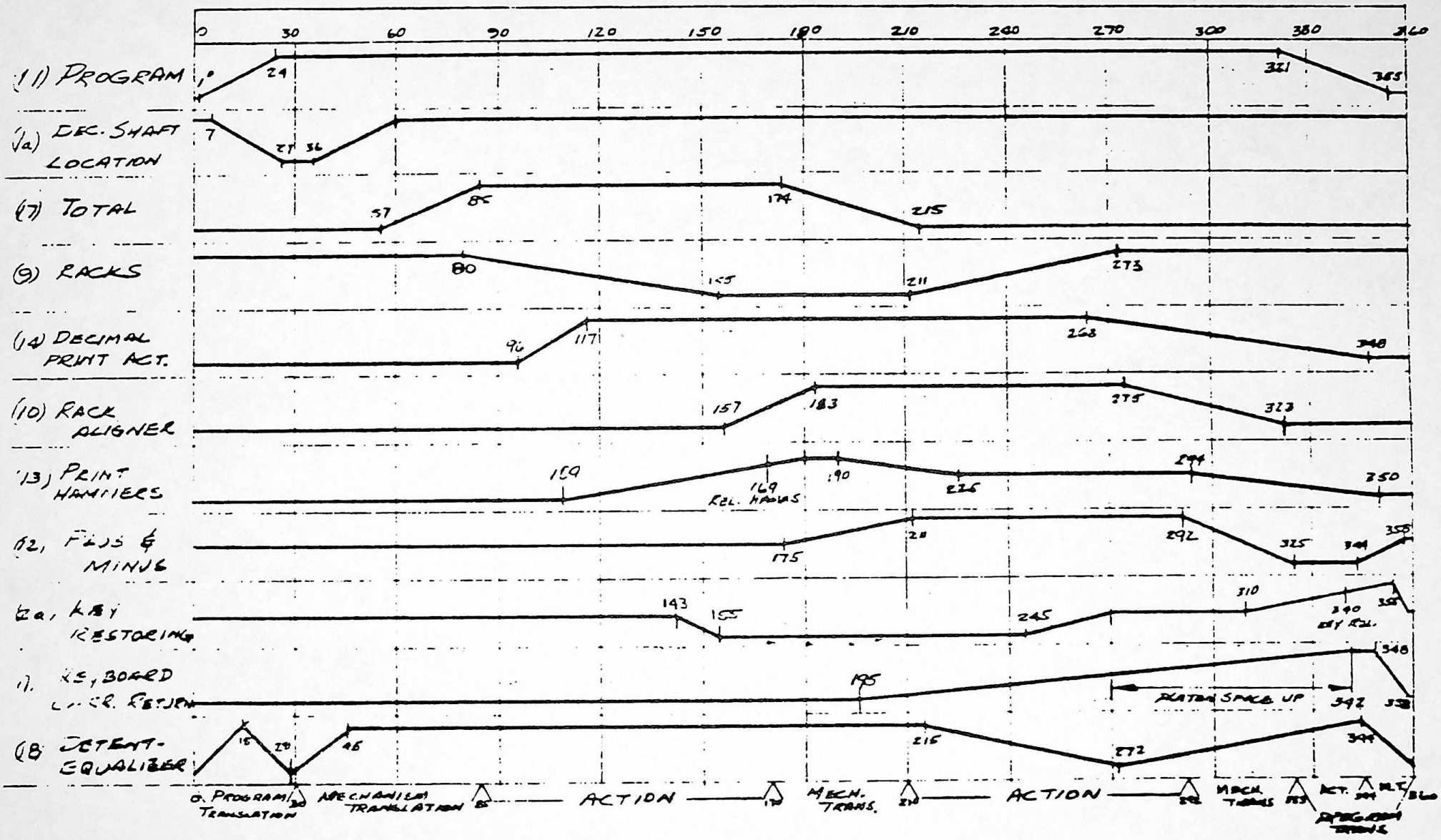
1.) CAMS LISTED IN SEQUENCE OF FIRST ACTION
2) REF: 'MAINSHAFT CAMS TIMING CHART 211 PC 192" FOR NUMBERS BESIDE CAMS

211 PC 192 "SUBTOTAL"

DHS 12-6-62

m 668
SH 2443

"DIVIDEND ENTRY" FUNCTION



1) CAMS LISTED IN SEQUENCE OF FIRST ACTION
2) REF: "MAINSHAFT CAMS TIMING CHART 211PC192" FOR NUMBERS BEHIND CAMS

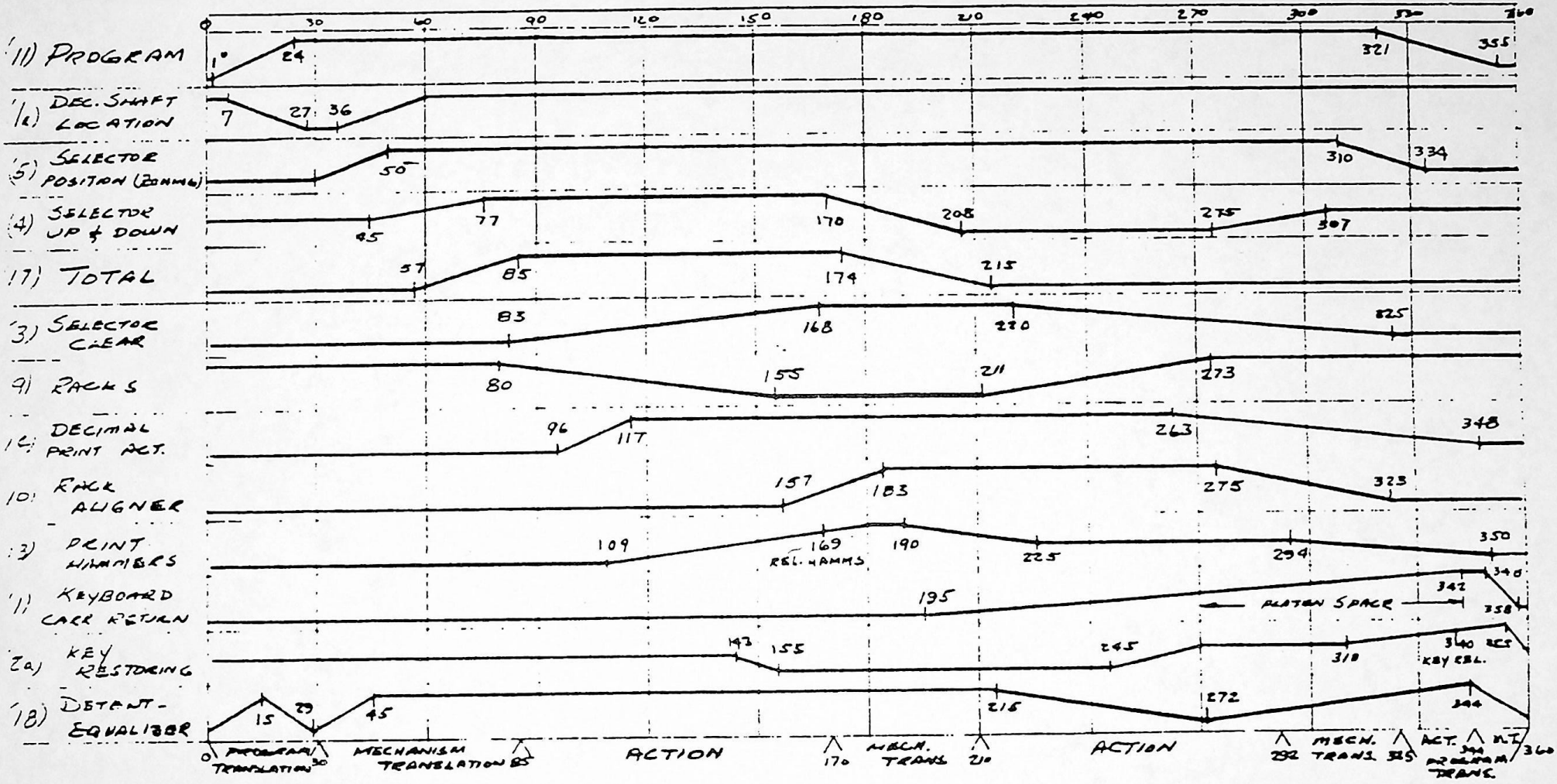
2HRCM2 DIVIDEND ENTRY

DMS 12-7-62

M668

"SELECTOR ENTRY" FUNCTION

X


30 60 90 120 150 180 210 240 270 300 330 360
(11) PROGRAM
1° 24 321 355
(1c) DEC. SHAFT LOCATION
7 27 36
(5) SELECTOR POSITION (ZONING)
50 310 334
(4) SELECTOR UP & DOWN
45 77 170 208 275 307
(7) TOTAL
57 85 174 215
(3) SELECTOR CLEAR
83 168 220 325
(9) RACKS
80 155 211 273
(12) DECIMAL PRINT ACT.
96 117 263 348
(10) RACK ALIGNER
157 183 275 323
(13) PRINT HAMMERS
109 169 REL. HAMMS 190 225 294 350
(1) KEYBOARD CARR RETURN
195 342 PLATEN SPACE 340 358
(2a) KEY RESTORING
143 155 245 318 340 KEY CBL.
(18) DETENT-EQUALIZER
15 29 45 215 272 344
0 PROGRAM TRANSLATION 30 MECHANISM TRANSLATION 85 ACTION 170 MECH. TRANS 210 ACTION 292 MECH. TRANS 325 ACT. 344 PROGRAM TRANS. N.T. 360

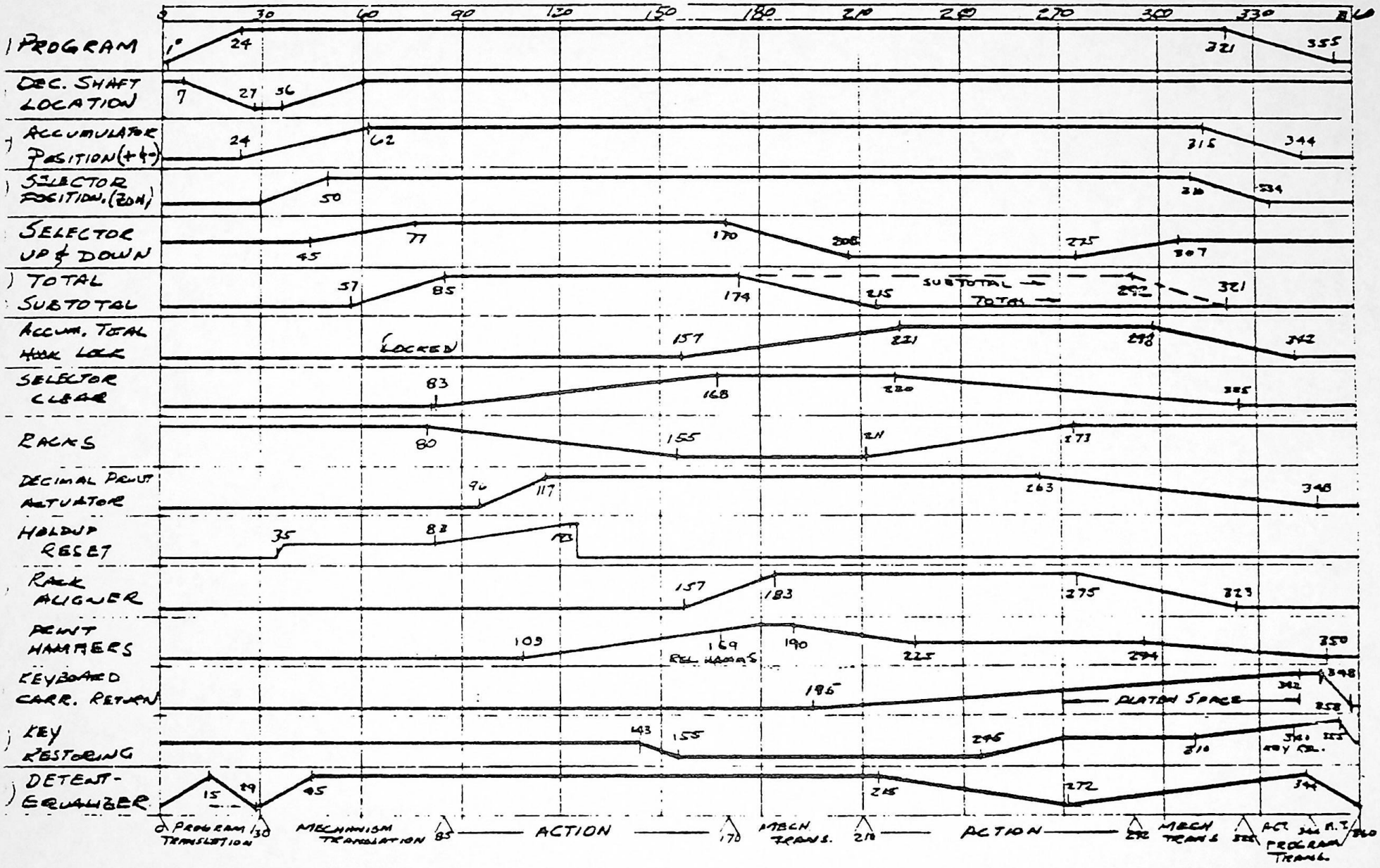
1.) CAMS LISTED IN SEQUENCE OF FIRST ACTION

2) REF: "MAINSHAFT CAMS TIMING CHART - 211PC192" FOR NUMBERS BESIDE CAMS

DNS 12-7-67

#668
4 2446

SELECTOR ENTRY — "TRANSFER" (#4 0) FUNCTIONS



1.) CAMS LISTED IN SEQUENCE OF FIRST ACTION

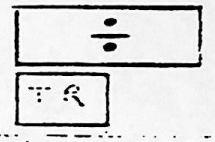
2.) REF: "MAINSHAFT CAMS TIMING CHART - 211PC192" FOR NUMBERS BESIDE CAMS

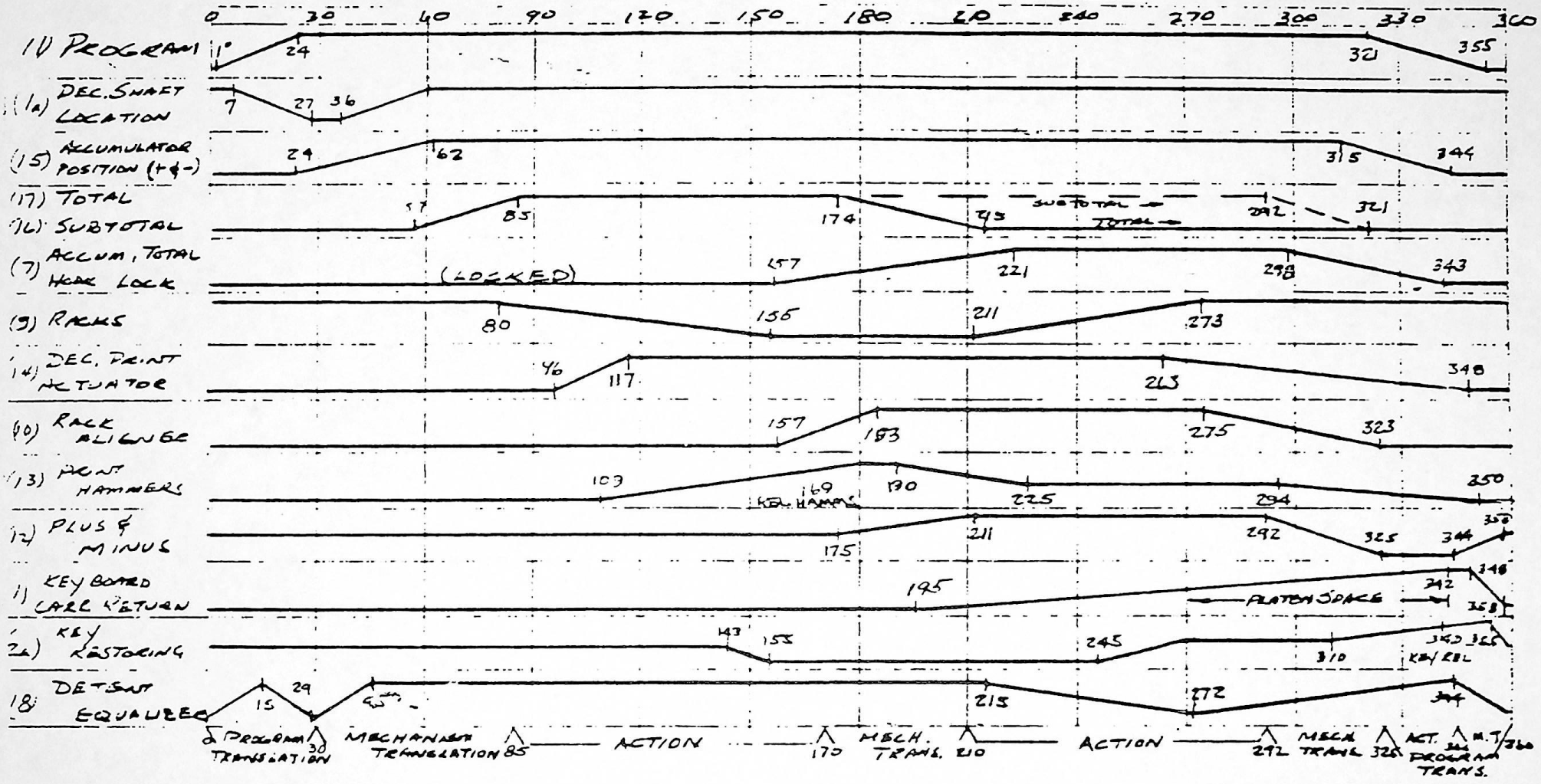
SELECTOR ENTRY - TRANSFER - #4 0 211PC192

DMS 12-62

MGLB

"DIVIDEND ENTRY - TRANSFER" (*÷◊)




0 30 40 90 120 150 180 210 240 270 300 330 360
IV PROGRAM
1° 24 320 355
(1a) DEC. SHAFT LOCATION
7 27 36
(15) ACCUMULATOR POSITION (+◊-)
24 62 315 344
(17) TOTAL
(16) SUBTOTAL
57 85 174 193 SUBTOTAL TOTAL 292 321
(7) ACCUM. TOTAL HOLD LOCK
(LOCKED) 157 221 298 343
(9) RACKS
80 156 211 273
(14) DEC. PRINT ACTUATOR
96 117 263 348
(10) RACK ALIGNER
157 183 275 323
(13) PRINT HAMMERS
103 169 KEY HAMMER 190 225 294 350
(12) PLUS & MINUS
175 211 292 325 344 350
(1) KEY BOARD CARR. RETURN
195 PLATEN SPACE 342 348 358
(24) KEY RESTORING
143 155 245 310 340 345 KEY REL
18 DETENT EQUALIZER
15 29 215 272 304
PROGRAM TRANSLATION 30
MECHANISM TRANSLATION 85
ACTION
170 MECH. TRANS. 210
ACTION
292 MECH TRANS 325
ACT. 345 PROGRAM TRANS. M.T. 360

1) CAMS LISTED IN SEQUENCE OF FIRST ACTION

2) REF: "MAINSHAFT CAMS TIMING CHART 211PC192" FOR NUMBERS BESIDE CAMS.

SECTION VI

SUPPLEMENTARY INFORMATION

Please insert this revised lubrication instruction sheet in proper sequence in your copy of C.S.B. #P2-502. This sheet replaces the previously issued lubrication information sheet (page VI-A-1, Rev. 12-64), which should be removed from your copy and destroyed.

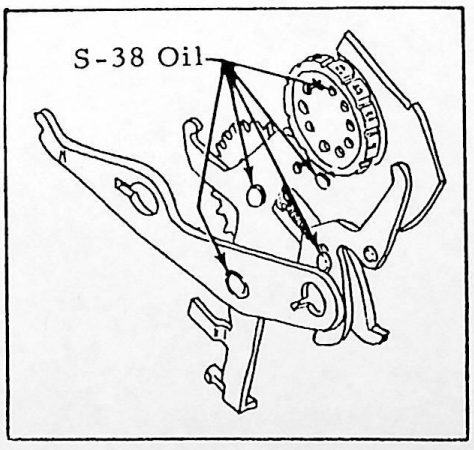
Lubricant		Application
Acc.	Name	
'B'	Spinesso #38 (S-38) Oil	Main shaft bearings. (Oil holes). General: All rotary metal to metal bearing surfaces except as otherwise specified hereon.
'G'	Estan #1 (Castro) Grease	Set-up clutch and Main shaft clutch drive (ratchet) gears. (Apply light coating). Gear Box (Use liberally).
'EE'	Gulf Plastic 'B' Grease	Decimal Unit: escapement gear and its pawl tips, front and rear positioning slides and sensing "shoes". Set-up carr. positioning cam shaft gear. Pinion gears in keyboards. (Only when disassembled). Rack guide combs and bars. (No oil or grease on rack teeth). Platen ratchet gear and ribbon post ratchet gears. Large plastic gear for main shaft. General: latching surfaces, flat sliding contact surfaces and cam surfaces except as otherwise specified hereon.
'RR'	Keystone Grease #53	Main shaft cams and their rollers. Tab shaft locating arm ("Crown").
	"Uniflo"* Motor Oil	Nyliner bearings in Decimal and Platen units and on Drive shaft. Plastic bearings on shaft in rack unit. Program cam shafts. Decimal control fingers. All Plastic gears (selector, register, accumulator, M/Q, etc.) except those in set-up carriage**. All moving parts in Carry unit. Mult. sensing mechanism (bails, fingers and guide comb). General: all moving Delrin and Celcon (Plastic) parts except as otherwise specified hereon.

CAUTION:

Do not lubricate Rack Teeth or Gears on hammers. (If hammer print unit is disassembled and cleaned, the pivot stud of each gear on each hammer should be lubricated. . . . Apply a single drop of Acc. 'B' (S-38 oil) to the points indicated in picture.
Note: Apply oil to print wheel pivot stud thru hole in print wheel. Wipe excess from all points).

* Uniflo should be purchased locally (available at any Humble Oil Co. Service Station).

** When set-up carriage is disassembled, a very light "wipe" of Uniflo should be applied to the shafts only, before re-assembly.



Please insert this supplement (pages VI-D-1 thru VI-D-9) in proper sequence in your copy of Calculator Service Bulletin #P2-502.

This supplement covers mechanical revisions in the PC 1421 which affect "Set-Up Carriage" alignment and "Selector" capacity.

SET-UP CARRIAGE ALIGNMENT

The decimal alignment mechanism has been revised to provide for proper alignment of Set-Up Carriage entries to the Selector and M/Q gears with one Decimal Control Knob set at "0" and the other at "3" or more....Previously the Set-Up Carriage entry controlled by the "0" setting would align one column to the left of the correct column.

To accomplish proper alignment, an additional stop step was added to the right end stop cam on the middle (selector) and lower (multiplier) decimal stop shafts.

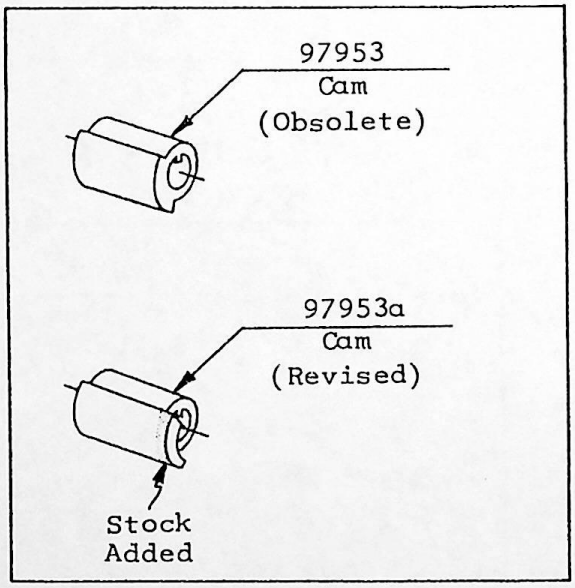
ALL MACHINES CURRENTLY IN THE FIELD WHICH DO NOT CONTAIN THESE REVISED STOP CAMS MUST BE CONVERTED.

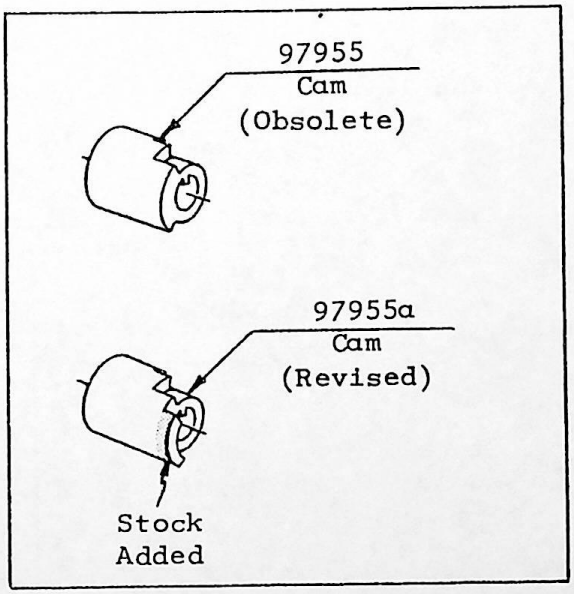
Installation of the following parts is required:

Middle Shaft	97953a Cam	replaces	97953 Cam*
Lower Shaft	97955a Cam	replaces	97955 Cam*

*Obsolete - return to General Service Department for credit.

Disassembly and assembly instructions are provided on pages VI-D-3 thru VI-D-9.





ELEVEN DIGIT CAPACITY SELECTOR AND RELATED FUNCTION KEY CAPACITY LOCKS

NOTE: Beginning with serial No. B-691606 all subsequent production PC-1421 (211PC192) machines will contain this revision.

(*Installation of this revision is optional).

The reasons for the change in capacity of the Selector are covered on page V-B-3 (last three paragraphs).

To accomplish eleven digit Selector entry capacity, a fixed selector gear was substituted for the leftmost setable selector gear.
NOTE: "Twelve column" Selectors cannot be converted to "Eleven column" Selectors... when installing this revision, the complete selector must be replaced.

The capacity locking mechanism has also been revised to coincide with the eleven column Selector. The left facing capacity sensing steps on the middle (Selector) Decimal Stop Shaft were moved one step to the left by altering the two center stop cams. As a result, the selector capacity Sensing Shoe will be activated one column sooner.

WHEN INSTALLING THE REVISED SELECTOR, THE RELATED CAPACITY STOP CAMS, WHICH COINCIDE WITH THE REVISED SELECTOR CAPACITY, MUST ALSO BE INSTALLED.

The revised Selector capacity lock parts can be installed at the same time the 97953a and 97955a stop cams (described on the preceding page) are installed.

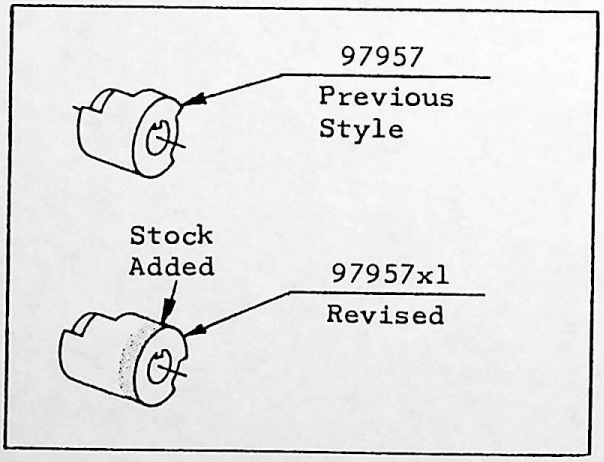
NOTE: The middle decimal stop shaft was also revised. The retainer groove for the left stop cam retainer was moved one step to the left to accomodate the revised stop cams. (97-002x2 shaft replaces 97-002xla). It is not necessary however, to replace this shaft when converting field machines. The 97-002xla shaft can be used by substituting a 59360 collar and 63749 set screw for the 60936 retainer.

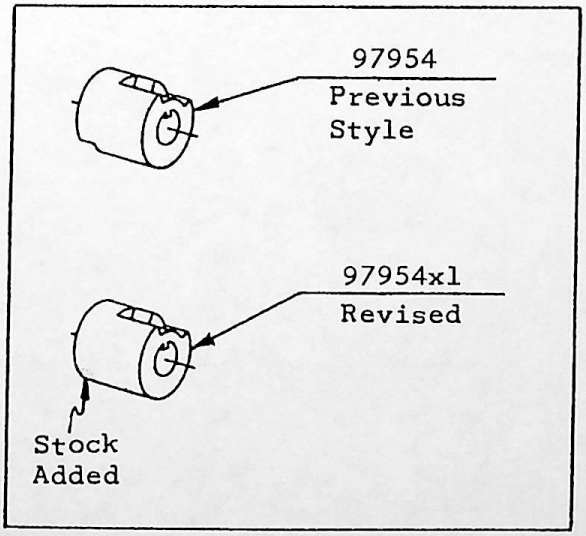
Material required:

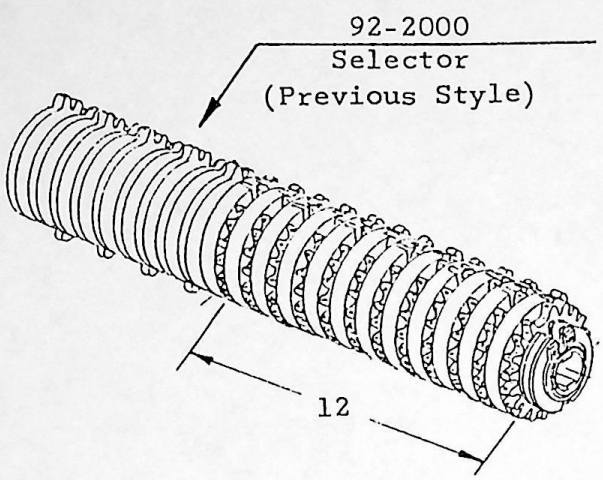
59360 Collar
63749 Set Screw } replaces 60936 Retainer
97957x1 Cam ..... replaces 97957 Cam*
97954x1 Cam ..... replaces 97954 Cam*
92-2000x1 Selector ..... replaces 92-2000 Selector*

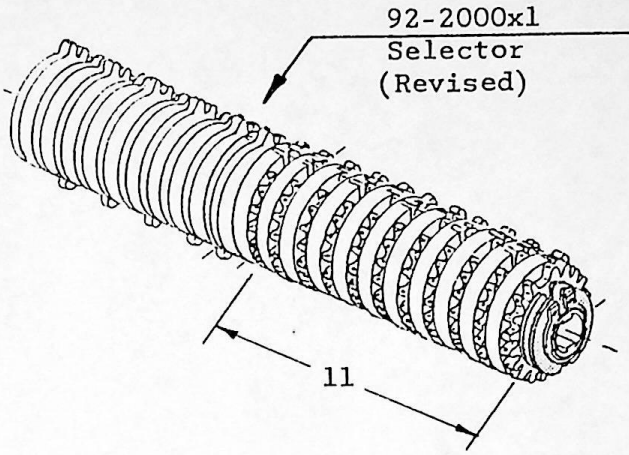
*Return to General Service Department for credit.

Please post part number changes from this and the preceding page in your copy of the temporary parts catalog.

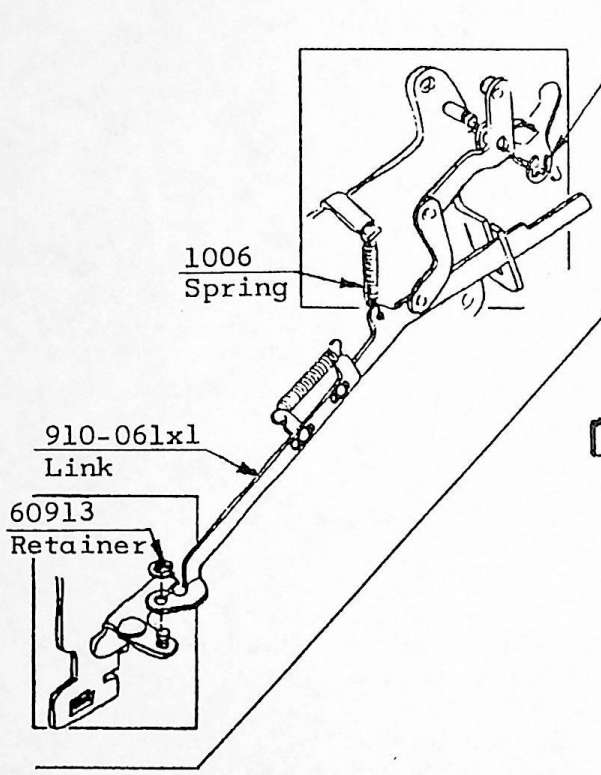




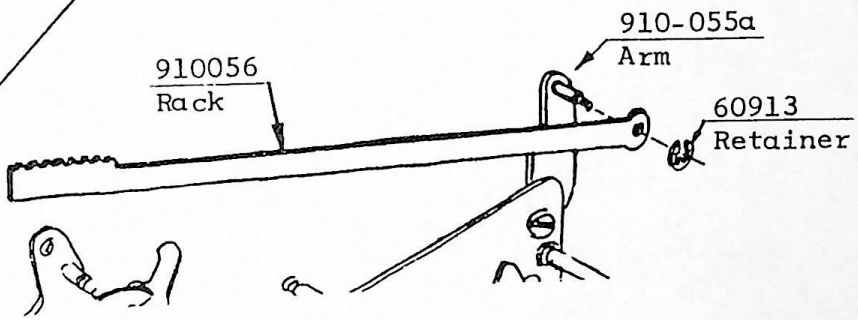




INSTALLATION PROCEDURE

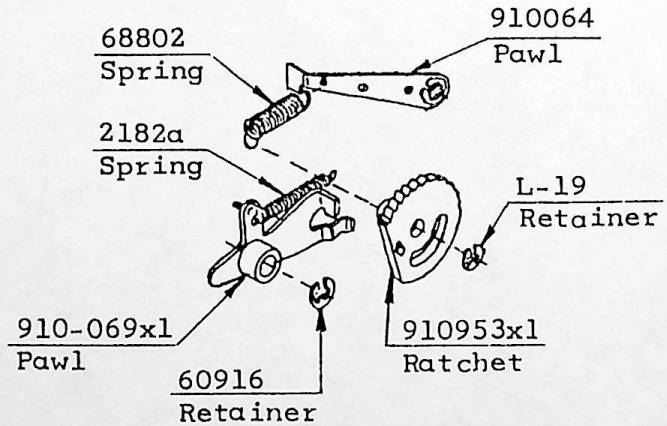


Remove (2) 60913 retainers, unhook 1006 spring and remove escapement link 910-061x1.



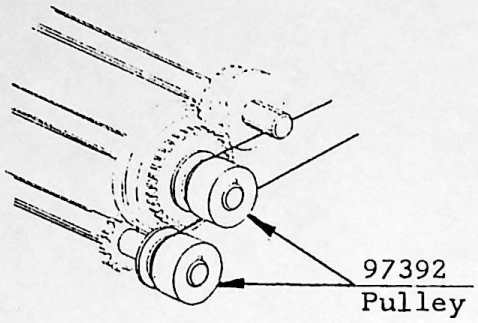
Remove 60913 retainer from 910-055a arm, move 910056 rack rearward to remove.

Note: During assembly, time gear as outlined on page IV-C-10.



Unhook spring 2182a from the frame... unhook 68802 spring and swing pawl 910064 rearward.

Remove L-19 retainer from the 910953x1 cam...remove 60916 retainer from 910-069x1 pawl and remove cam and pawl.



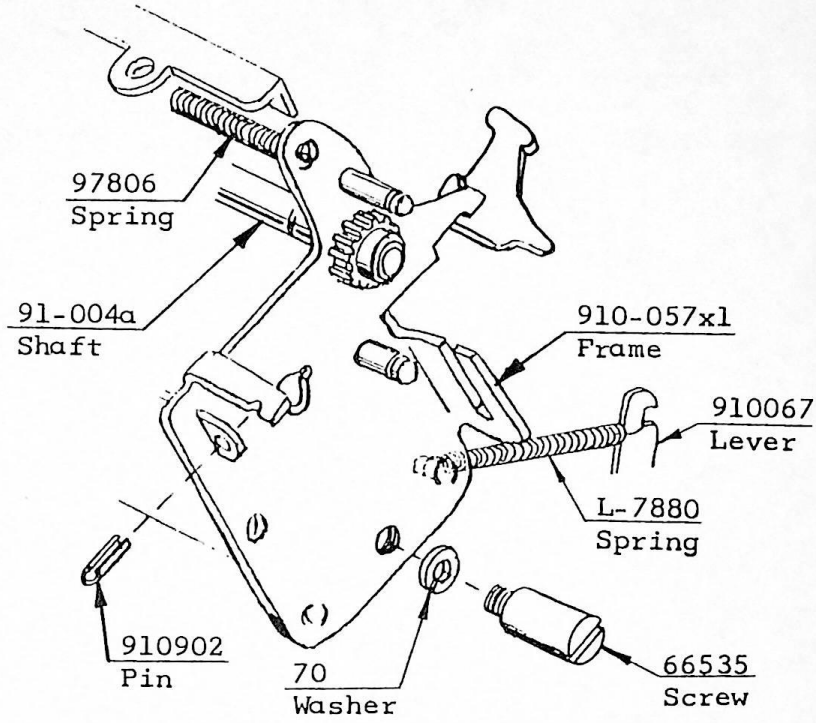
Remove 97392 decimal cable pulleys from the middle and lower decimal shafts.

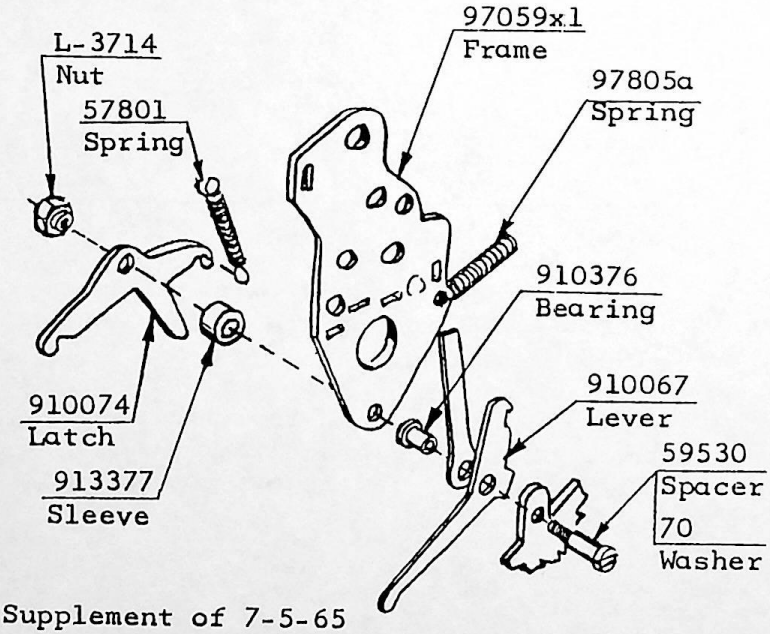
Remove 66535 screw and #70 washer from the 910-057x1 frame...unhook spring 97806 from the frame...remove roll pin 910902.

Unhook L-7880 spring from the stud on the 910-057x1 frame,also remove the other end from the 910067 lever.

Remove 910-057x1 frame with the 91-004a set-up carriage shaft.

NOTE: Before installing the 910-057x1 frame, refer to page III-B-8 for timing of pinion gear to set up segment.





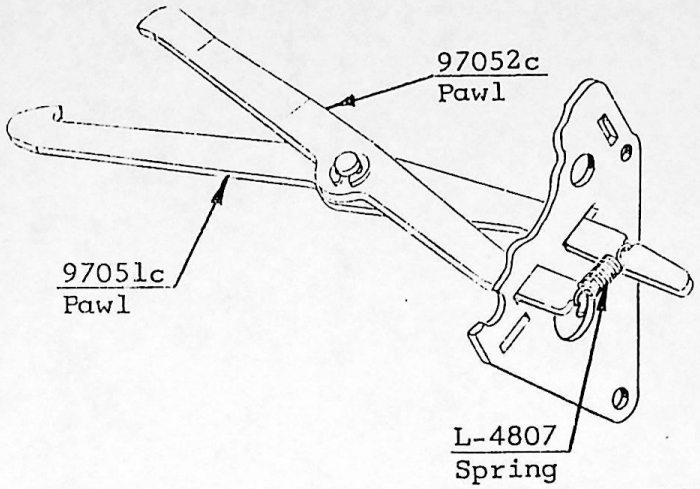
Unhook 97805a spring from the 97059x1 plate...unhook 57801 spring from the 910074 latch.

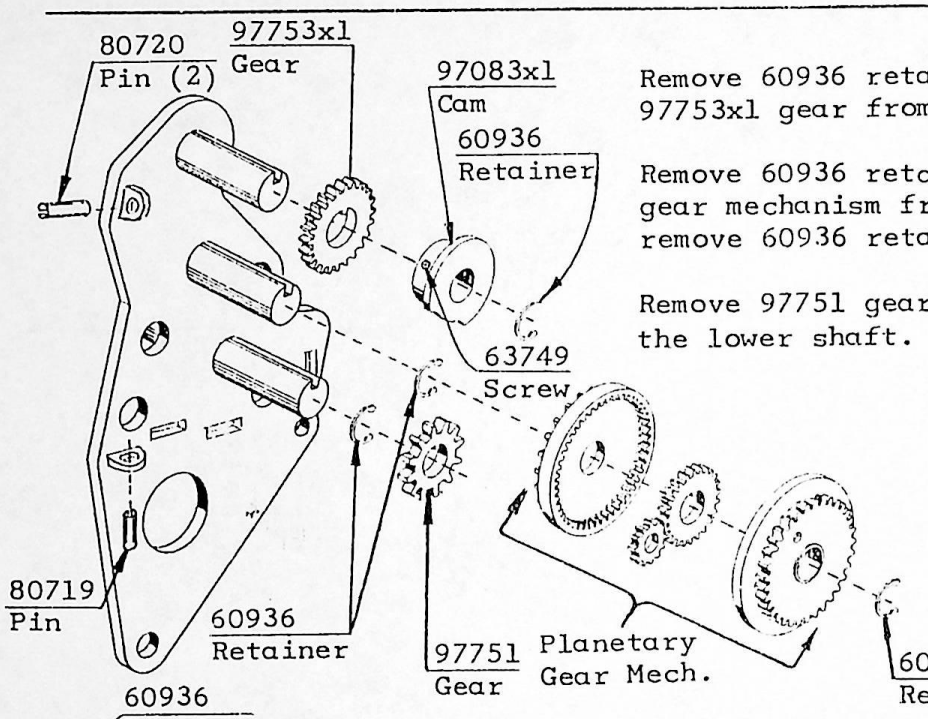
Loosen 59530 screw...remove L-3714 nut, 910074 latch with 913377 sleeve.

Remove 59530 screw, 70 lock washer, 910067 lever, 910376 bearing.

NOTE: When installing the 913377 sleeve be sure the chamfered side of the inside diameter faces the 97059x1 frame.

Remove L-4807 spring from the 97051c and 97052c pawls.





Remove 60936 retainer, 97083x1 cam and 97753x1 gear from the upper decimal shaft.

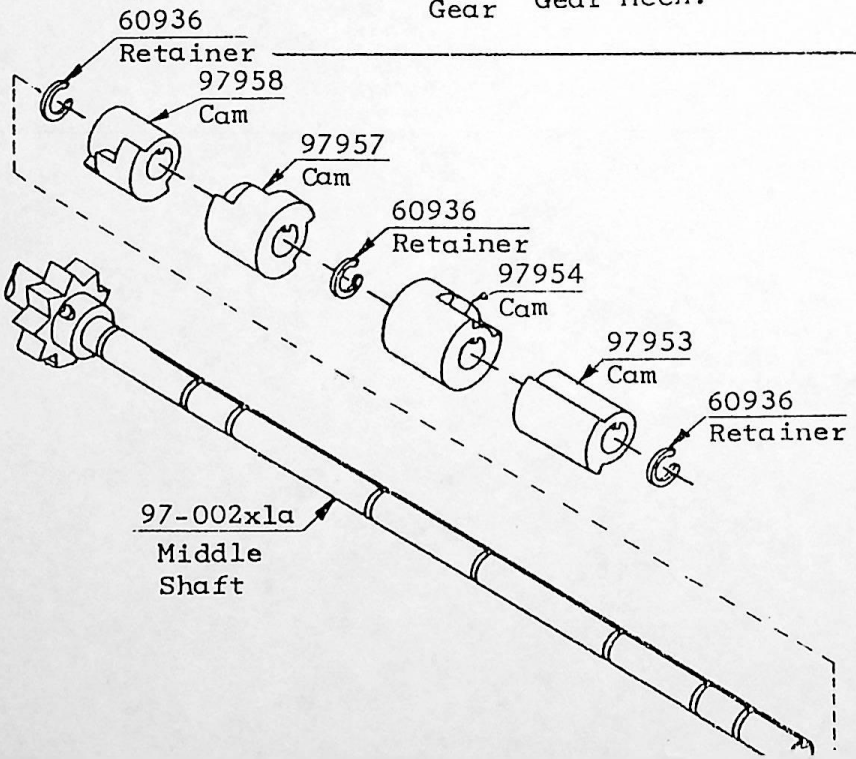
Remove 60936 retainer and withdraw planetary gear mechanism from the middle shaft... remove 60936 retainer from the shaft.

Remove 97751 gear and 60936 retainer from the lower shaft.

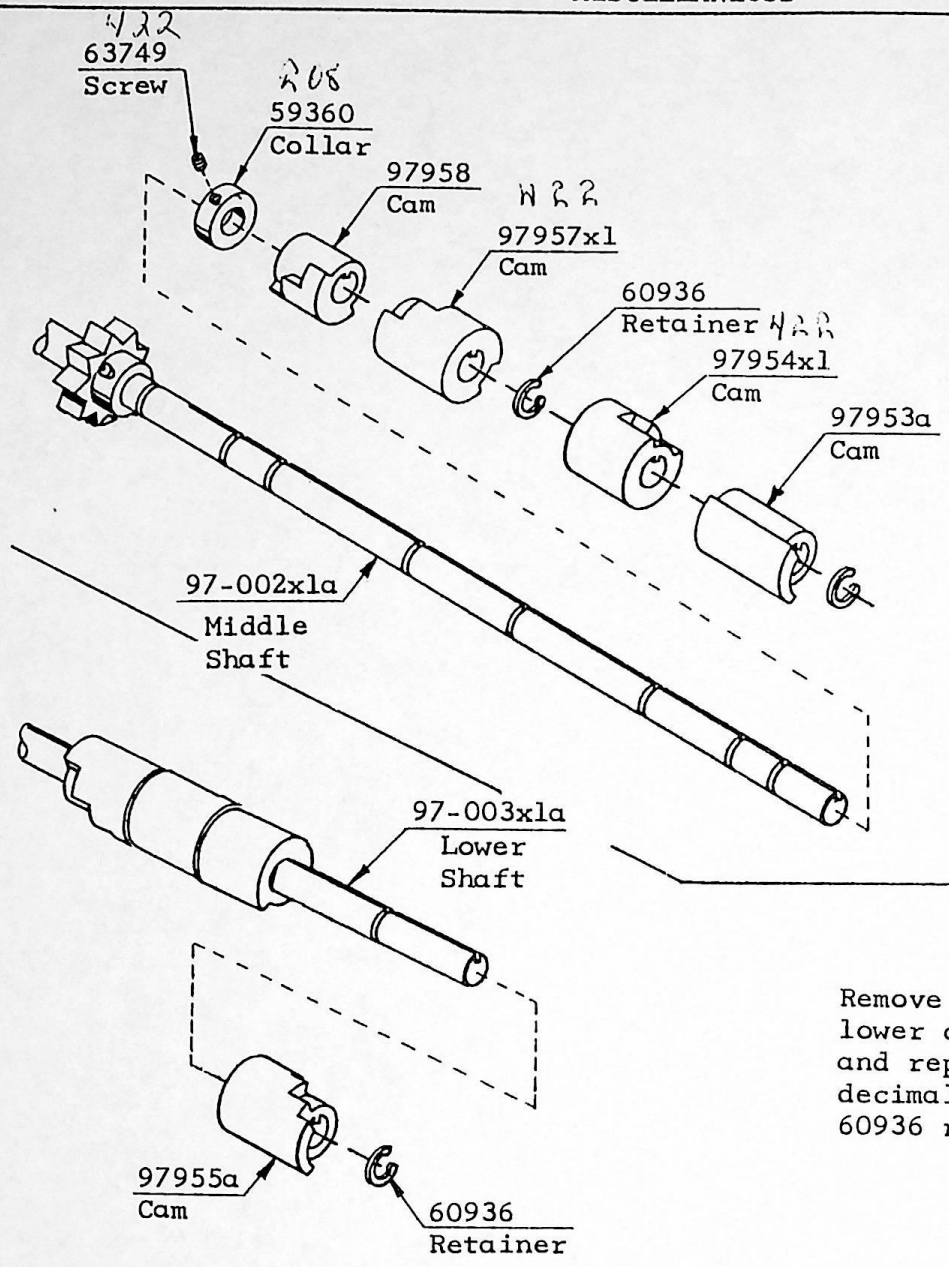
Remove (2) 80720 pins and 80719 pin from 97059x1 end plate.

Remove 97059x1 end plate by twisting in a clockwise direction.

NOTE: During assembly see page VI-D-7 for timing sequence.



Remove 60936 retainer from the middle decimal shaft 97-002x1a and replace decimal cam 97953 with 97953a, secure with 60936 retainer. If at this time you are also installing the 11 capacity selector, before installing the 97953a cam remove the 97954 cam, 60936 retainer, 97957 cam, 97958 cam, 60936 retainer and...

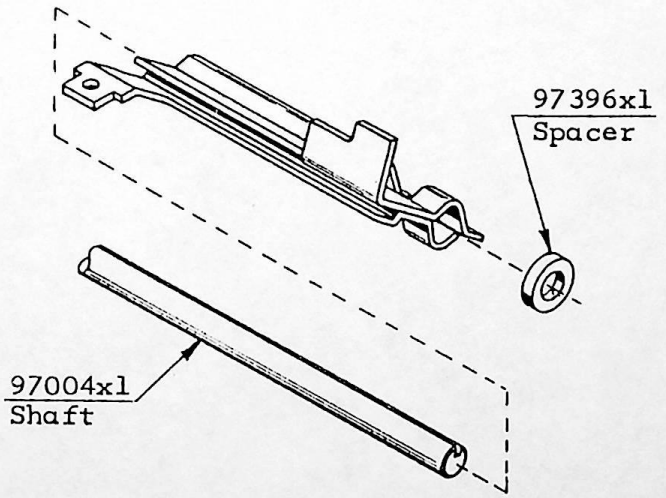


... install 59360 collar with 63749 set screw, 97958 cam, 97957x1 cam 60936 retainer, 97954x1 cam, 97953a cam, 60936 retainer. Remove end play of cams by moving collar to the right and securing set screw.

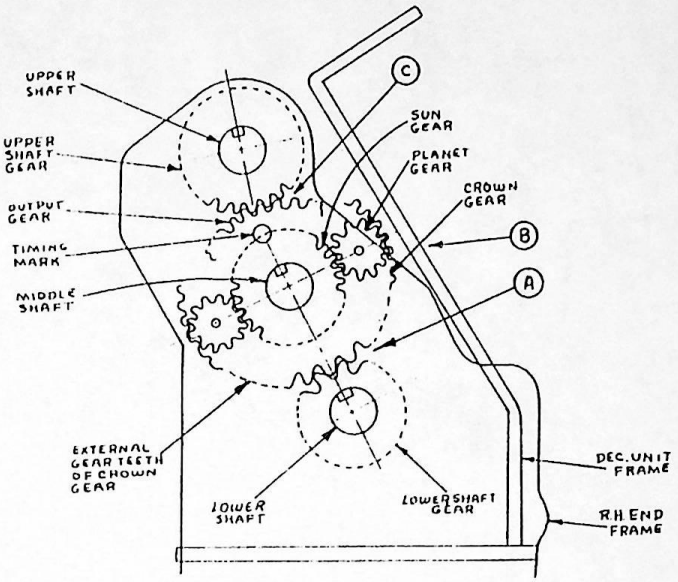
Remove 60936 retainer from lower decimal shaft 97-003x1a and replace 97955 with 97955a decimal cam, secure with 60936 retainer.

TO REASSEMBLE, REVERSE THE DISASSEMBLY PROCEDURE

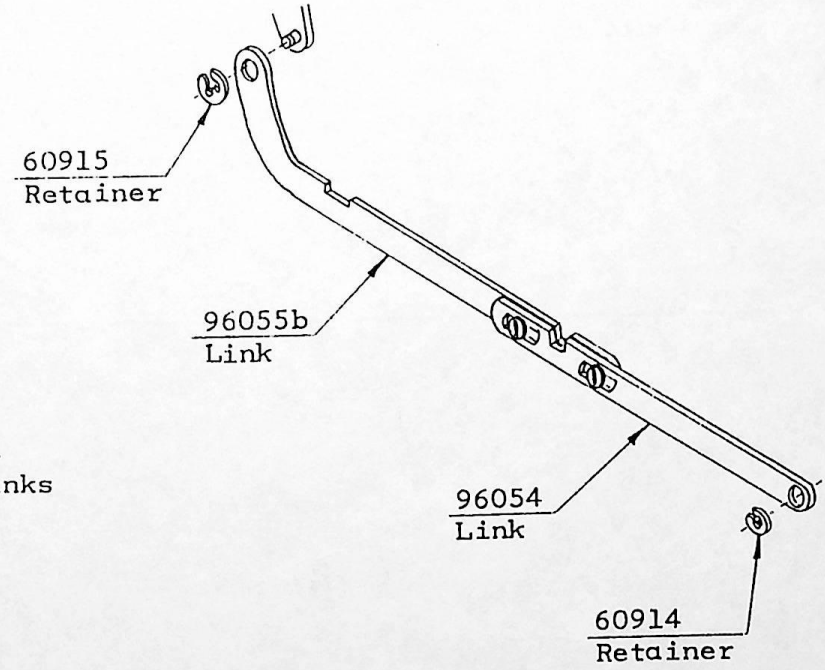
Before re-assembling the 97059x1 plate make sure the 97396x1 spacer is in place on the 97004x1 decimal control shaft.



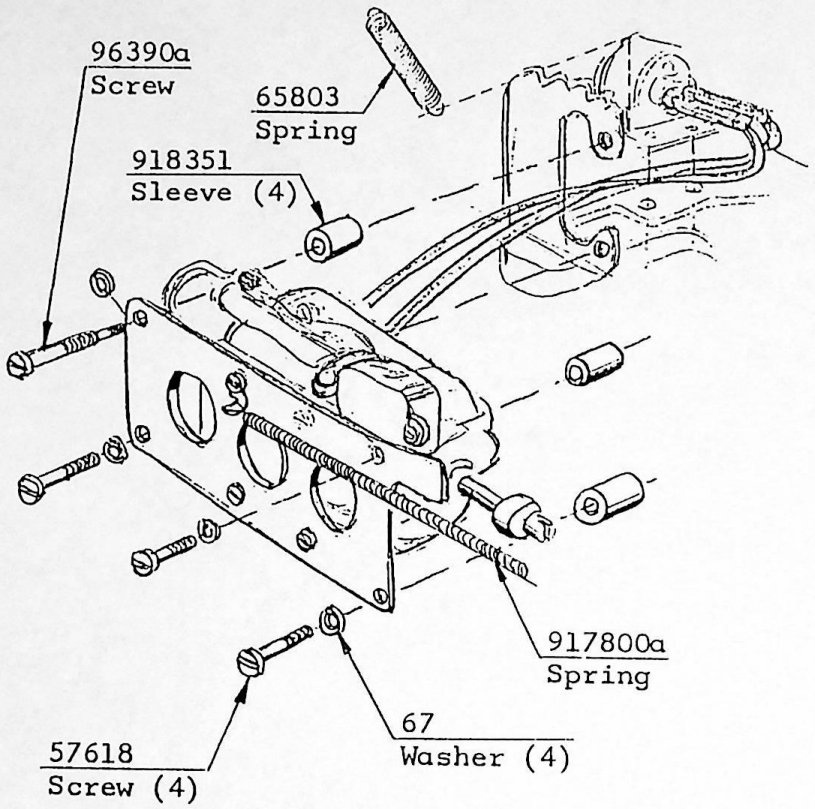
1) Decimals set at 1-1.
2) Assemble lower shaft gear on to lower shaft with keyway on centerline.
3) Assemble crown gear to middle shaft and time gear portion with lower shaft gear as shown at (A).
4) Assemble sun gear to middle shaft with keyway on centerline as shown.
5) Assemble planet gear disc with 2 planet gears and time with crown gear and sun gear as shown at (B). Timing mark on disc should be on same centerline as lower and middle shafts.
6) Assemble upper shaft gear to upper shaft and time with output gear as shown at (C).



TO REMOVE THE 92-2000 SELECTOR

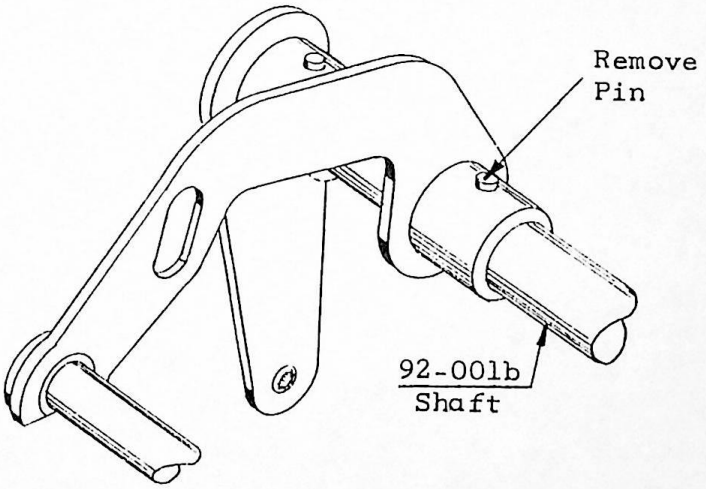


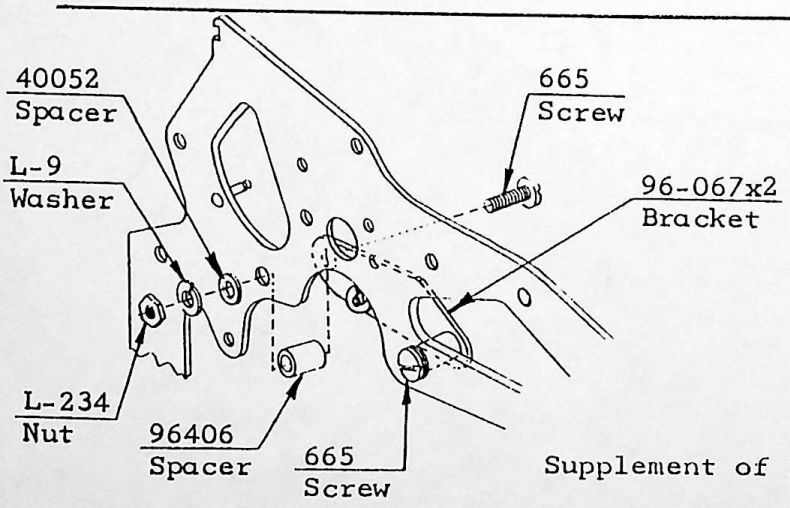
Remove retainers 60914 and 60915 to remove links 96055b and 96054.



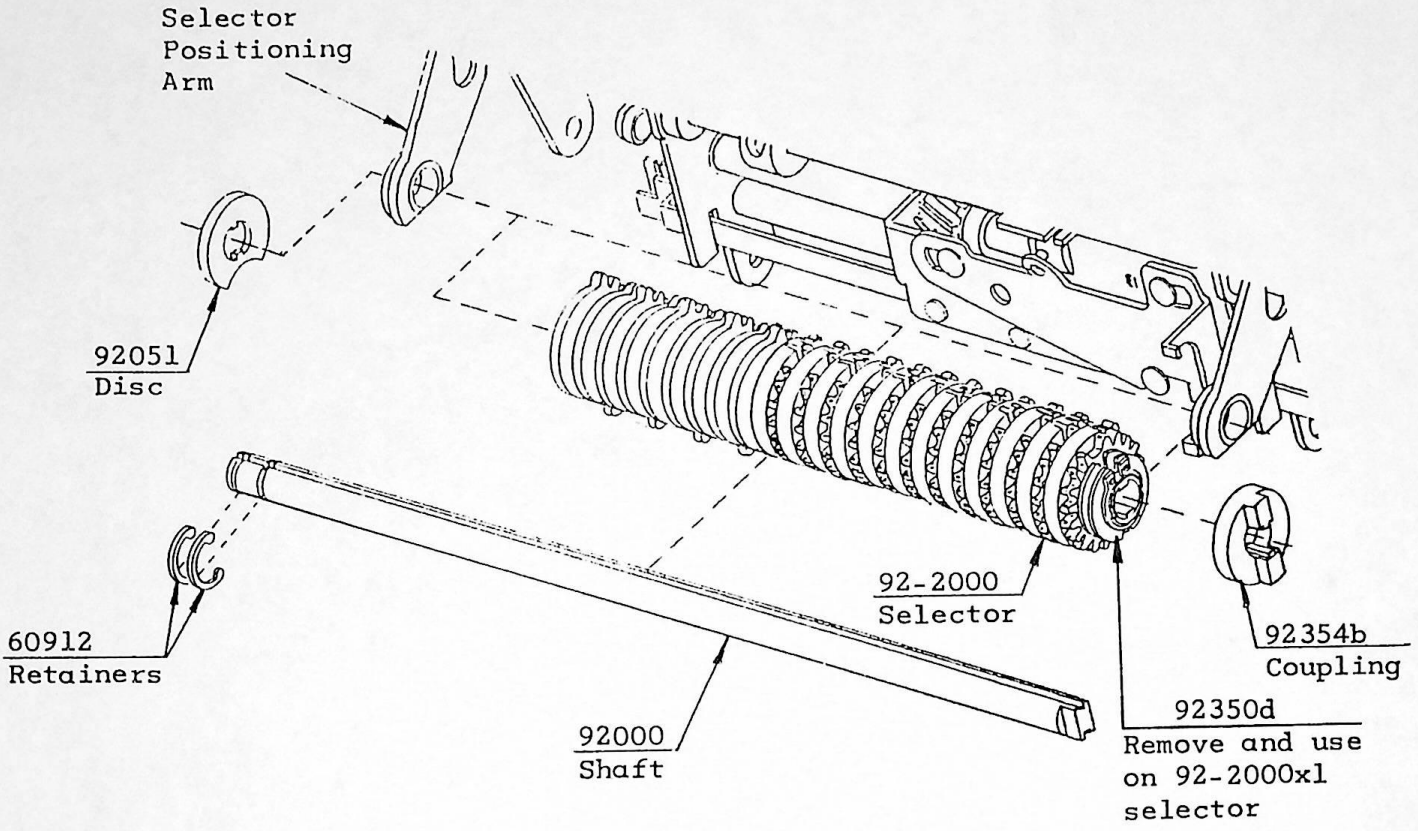
Turn machine on its right side. Unhook springs 917800a and 65803...Remove motor bracket screws 96390a (1), 57618 (3), 67 washers (4), 918351 sleeves (4). Move motor unit to one side.

Drive pin out of left arm on selector positioning shaft 92-001b.



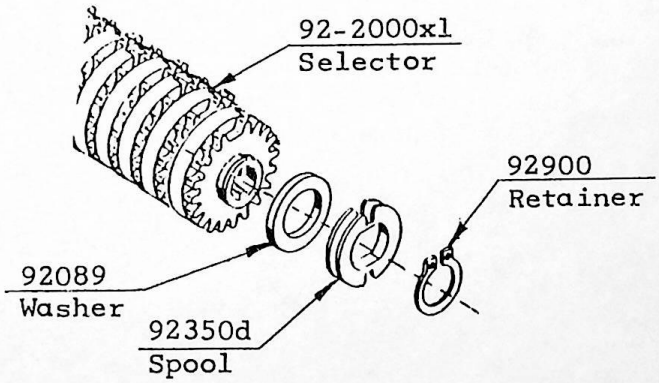


Loosen the forward #665 screw...remove the rearward #665 screw, 96406 spacer, 40052 washer, L-9 washer and L-234 nut from the 96-067x2 bracket and swing bracket out of the way



Remove two 60912 retainers from 92000 shaft...remove 92051 disc... remove 92000 shaft...be careful not to drop the 92354b coupling from its seat. Swing left arm of selector positioning arm out of the way. Remove selector 92-2000 to the left.

Before installing 92-2000xl selector, remove 92350d spool and replace with original spool from 92-2000 selector.



TO REASSEMBLE REVERSE THE DISASSEMBLY PROCEDURE

THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

Supplement of 9-17-65

Please insert this supplementary page in proper sequence in your copy of C.S.B. #P2-502.

ELECTRICAL CONNECTION SHIELDING AND E.I.E. FILTER INSTALLATION

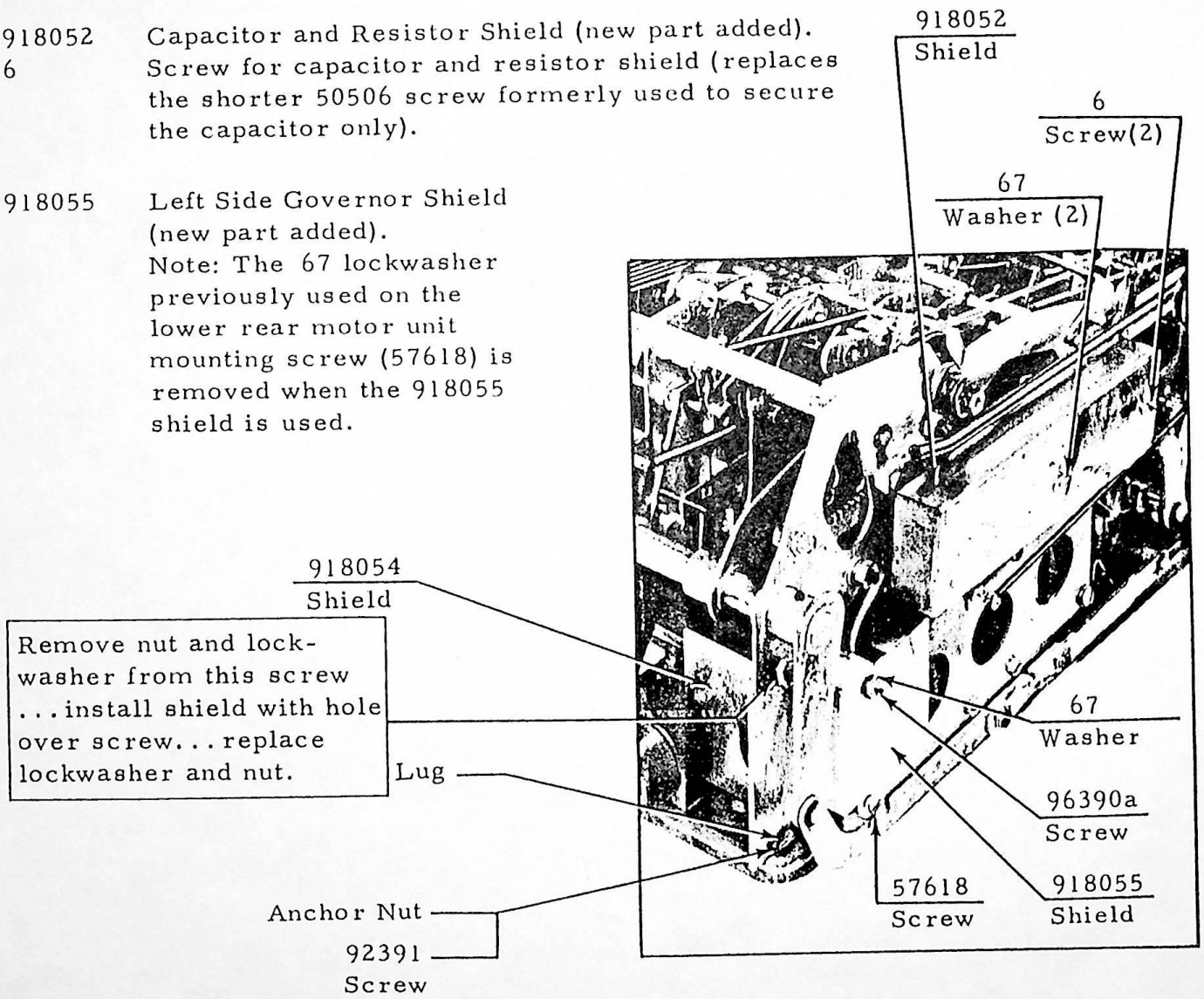
Metal shields for all exposed electrical connections have been added to all 211PC192 models produced beginning with Serial Number B-691520. This shielding is provided to meet the requirements for Underwriters Laboratories approval.

The following parts are required for this change:

918052 Capacitor and Resistor Shield (new part added).

6 Screw for capacitor and resistor shield (replaces the shorter 50506 screw formerly used to secure the capacitor only).

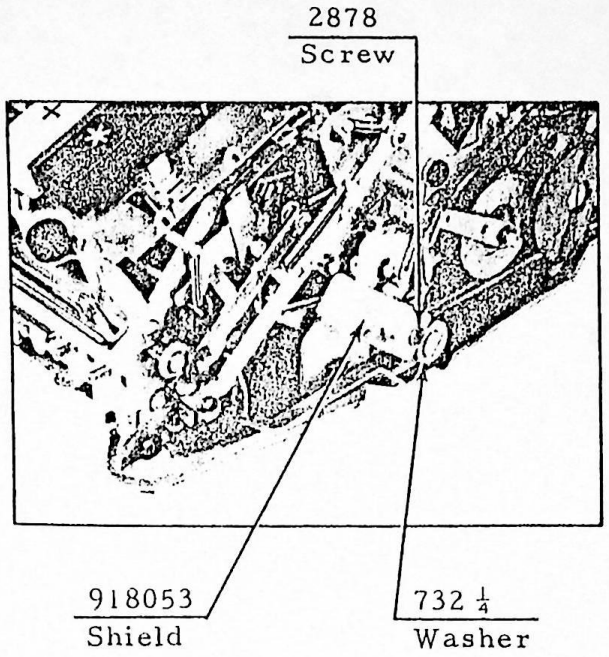
918055 Left Side Governor Shield (new part added).
Note: The 67 lockwasher previously used on the lower rear motor unit mounting screw (57618) is removed when the 918055 shield is used.



918054 Rear Governor Shield (new part added).

92391 Screw for left side frame rear anchor nut (replaces the long 57571 screw previously used, to provide clearance for lug of 918054 shield....The 46803b anchor nut retainer previously used here is also removed).

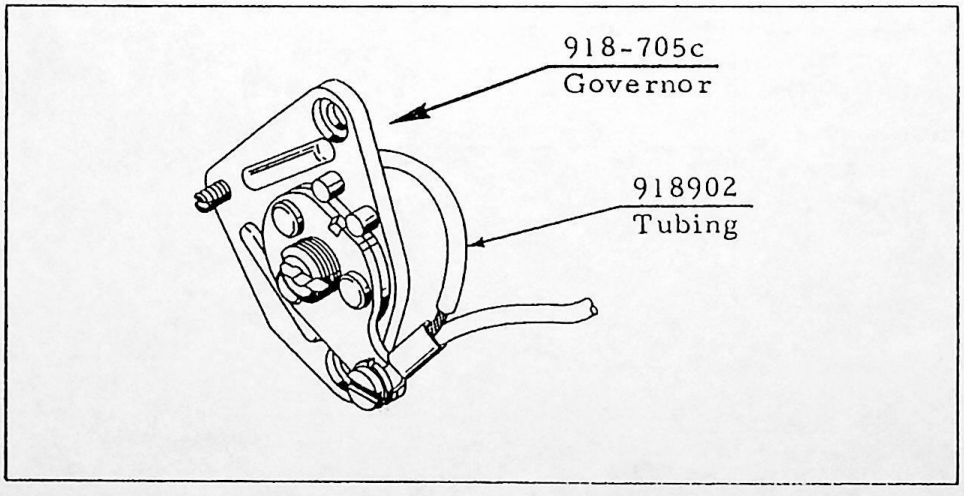
918053	Switch Shield (New part added).
2878	Screw for switch shield (replaces 13 screw in switch).
732-1/4	Washer (this smaller washer replaces 47064 washer on 59595 switch retaining screw to provide clearance for switch shield).



GOVERNOR JUMPER WIRE SHIELDING

A 3/4" length of temflex tubing has also been added to the governor jumper wire to meet U. L. requirements.

918-705c Governor (revised part. Replaces 918-705b. 918902 tubing added to shield bare jumper wire).



Please post the above part number changes in your copy of the Temporary Parts Catalog.

SPECIAL FEATURE #43

ELECTROMAGNETIC INTERFERENCE ELIMINATOR FILTER INSTALLATION (E.I.E.)

NOTE: The electrical connection shielding described on the preceding two pages (VI-D-11 and 12) is required as part of the E.I.E. feature....Therefore, if E.I.E. is to be installed on a machine that does not have the shielding, the shielding MUST also be installed.

To obtain both the E.I.E. feature parts and the shielding parts, fill out the requisition as follows:

1 Set Feature #43 with shielding for 211PC192 Serial No. _____.

To obtain the E.I.E. feature parts only (for installation on machines which already have the shielding), fill out the requisition as follows:

1 Set Feature #43 only, for 211PC192 Serial No. _____.

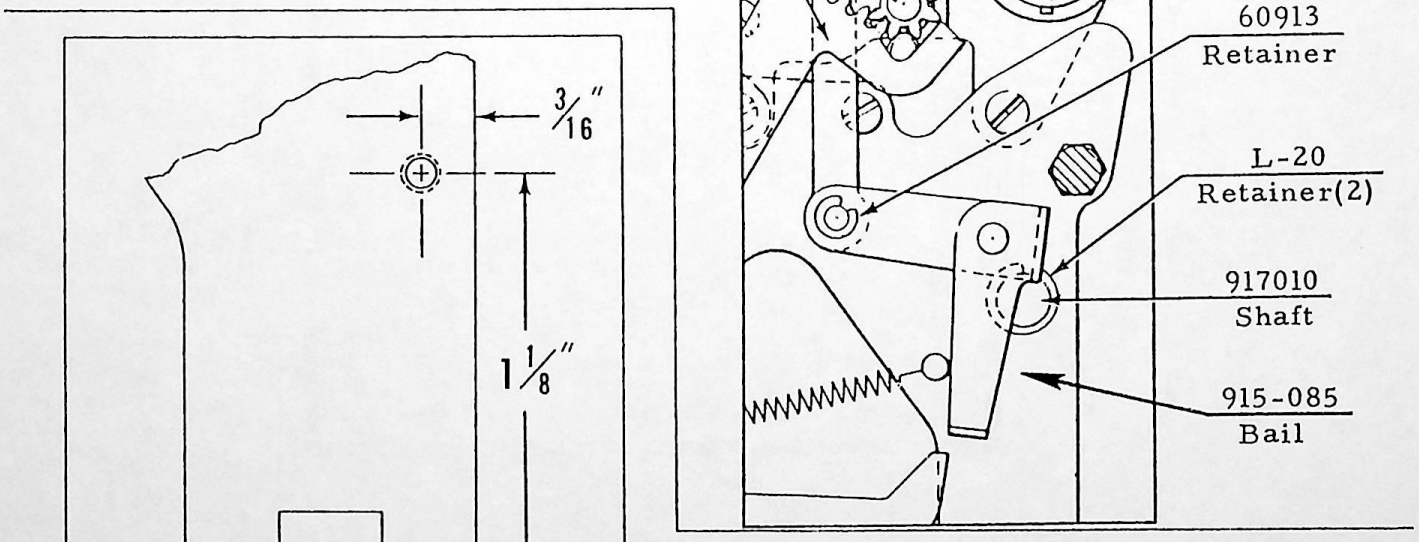
Be sure to include the serial number of the machine on which the feature is to be installed.

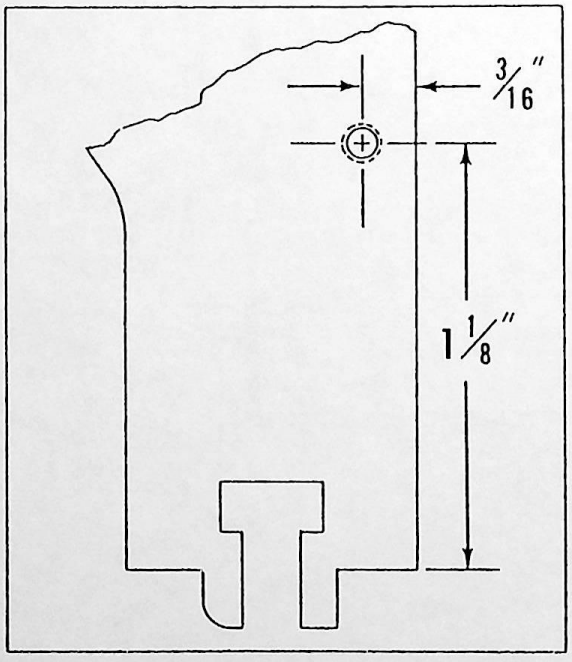
Installation Instructions:

1. Remove the 60913 retainer from the stud on the 915-085 starting bail and disconnect the bail from the 915084 "T" Arm.
2. Remove (2) L-20 retainers from the 917010 shaft, remove shaft completely.

   Note: This shaft, which is provided simply for handling purposes...to prevent damage to the quotient bail, must be omitted when the E.I.E. filter is installed. Servicemen then should be especially careful when handling such machines, not to lift them by gripping the quotient bail.

   Reassemble 915-085 bail to 915084 "T" Arm with 60913 retainer.





3. Center-punch hole position in left rear rack frame (the right frame as viewed from the rear) per illustration, drill #33 hole, thread with #6-40 tap.

Filter wiring parts furnished with Feature order:

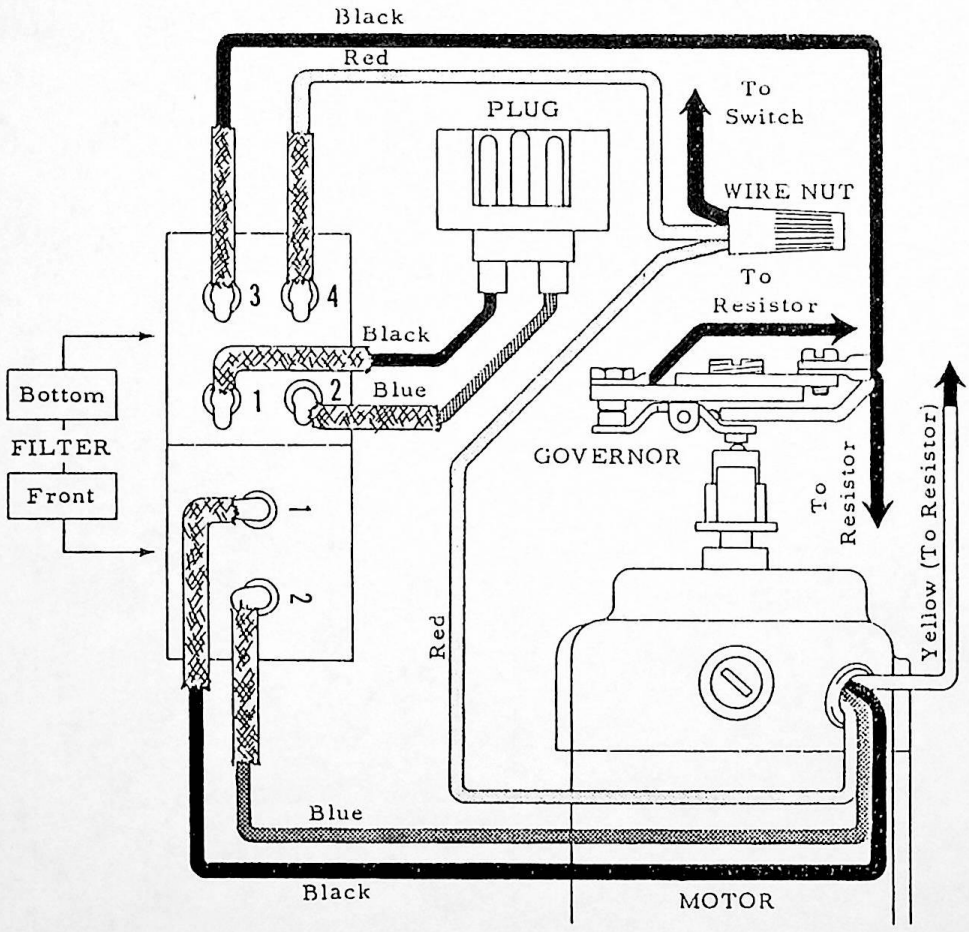
Number	Name	Amount
67928	Filter	1
60902	Sleeve	4
66905	Connector	1
2999	Wire (black)	10"
47914	Wire (red)	6"
47915	Wire (blue)	5"

a. Cut the 10" length of black wire (2999) into two equal pieces and solder one 5" length to the #1 terminal on the four terminal side of the filter. Slide one (60902) sleeve over the exposed connection.

b. Solder one 5" (47915) blue wire to the #2 terminal on the four terminal side of the filter. Slide one (60902) sleeve over the exposed connection.

c. Solder one 5" (2999) wire to the #3 terminal on the four terminal side of the filter. Slide one (60902) sleeve over the exposed connection. Solder the (66905) connector on the other end of this wire.

d. Solder one 6" (47914) red wire to the #4 terminal on the four terminal side of the filter. Slide one (60902) sleeve over the exposed connection.

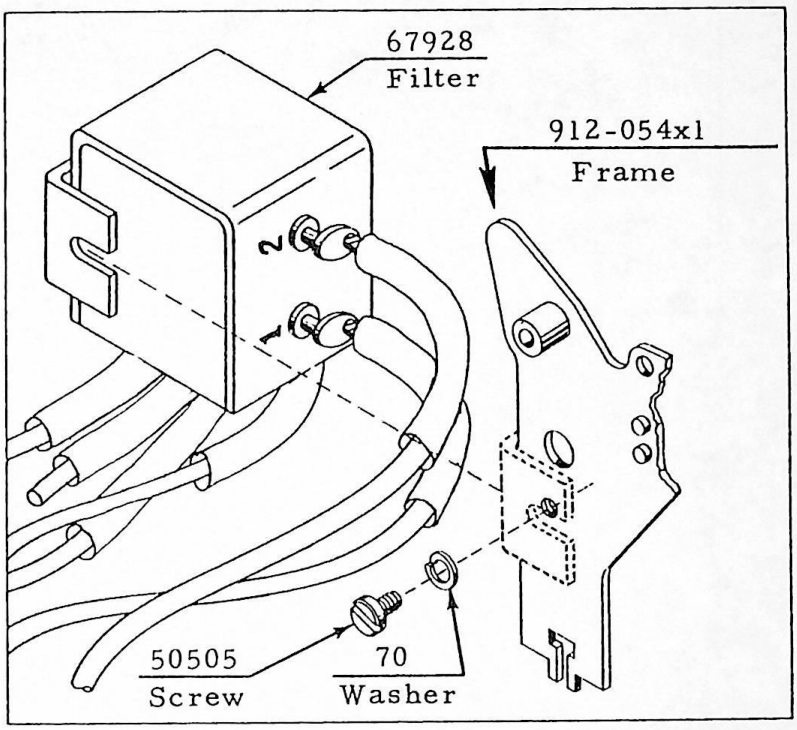


E.I.E. FILTER WIRING (Bottom View)

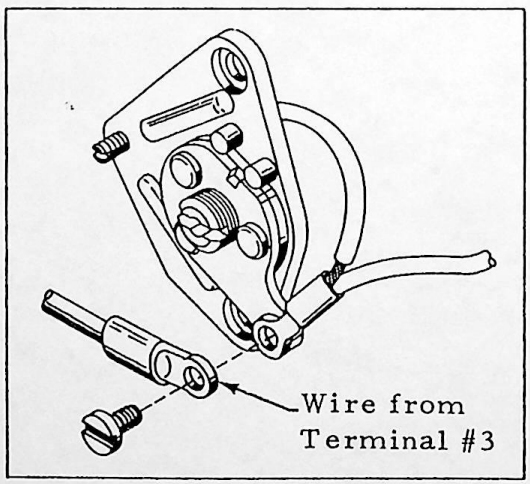
4. Dis-assemble the motor plug from the machine base and disconnect the lead wires from the plug.

5. Slide two (60902) sleeves on the black and blue wire from the motor. Solder black wire from motor (originally assembled to motor plug) to terminal #1 on the two terminal side of the filter and the blue wire from the motor to terminal #2 on the two terminal side of the filter. Slide sleeves over exposed connection.

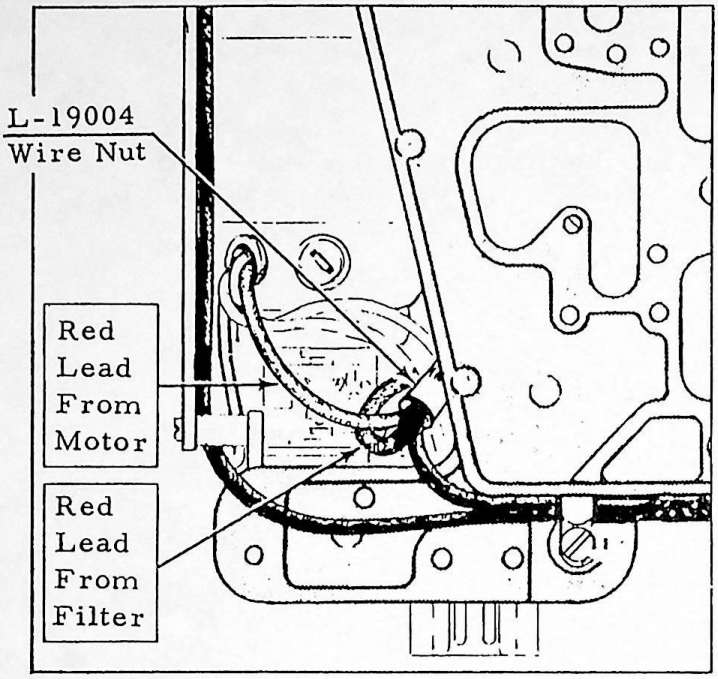
6. Install filter to rear rack frame as illustrated.



7. Install black and blue wires from terminals #1 and #2 of the four terminal side of filter in motor plug and reassemble plug to base plate.



8. Remove screw and lockwasher from metal portion of governor (as illustrated). Connect the black wire from terminal #3 of filter at this point and secure with the screw removed (omit lockwasher).



9. Remove the wire nut (L-19004), which connects the red motor lead to the switch lead, and connect the red wire from terminal #4 of filter to the other wires at this point. Re-install the wire nut. Check that all wiring is clear of moveable parts.

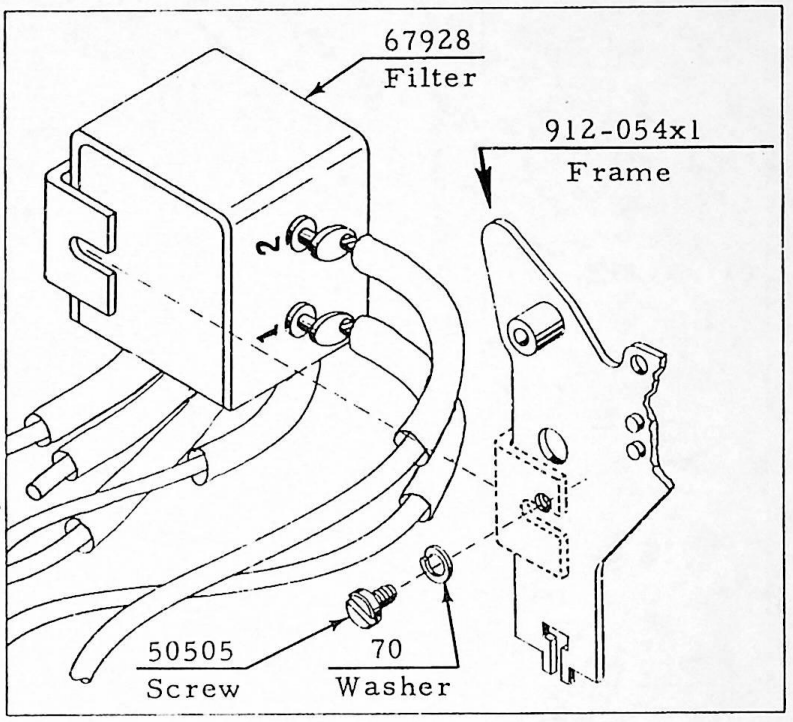
4. Dis-assemble the motor plug from the machine base and disconnect the lead wires from the plug.

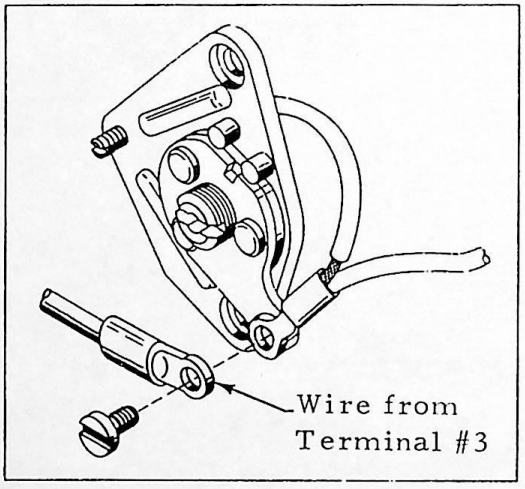
5. Slide two (60902) sleeves on the black and blue wire from the motor. Solder black wire from motor (originally assembled to motor plug) to terminal #1 on the two terminal side of the filter and the blue wire from the motor to terminal #2 on the two terminal side of the filter. Slide sleeves over exposed connection.

6. Install filter to rear rack frame as illustrated.

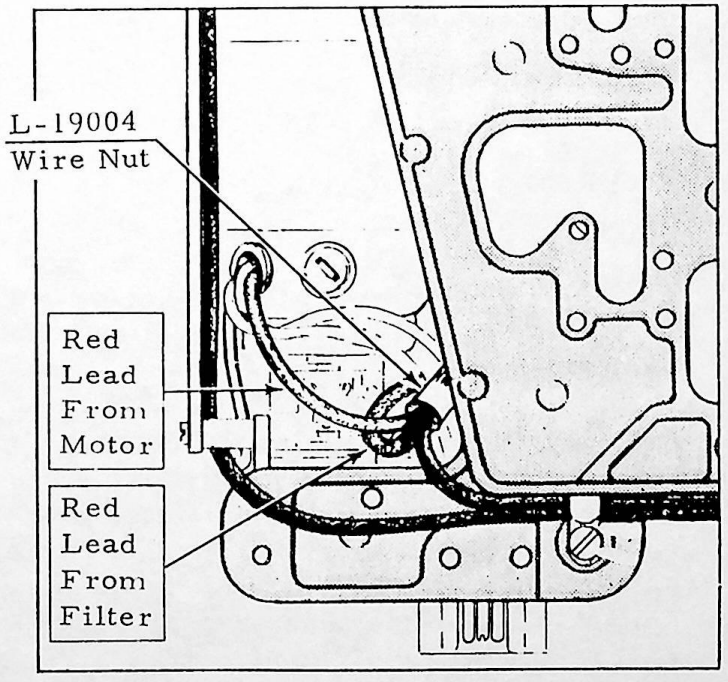
7. Install black and blue wires from terminals #1 and #2 of the four terminal side of filter in motor plug and reassemble plug to base plate.

8. Remove screw and lockwasher from metal portion of governor (as illustrated). Connect the black wire from terminal #3 of filter at this point and secure with the screw removed (omit lockwasher).



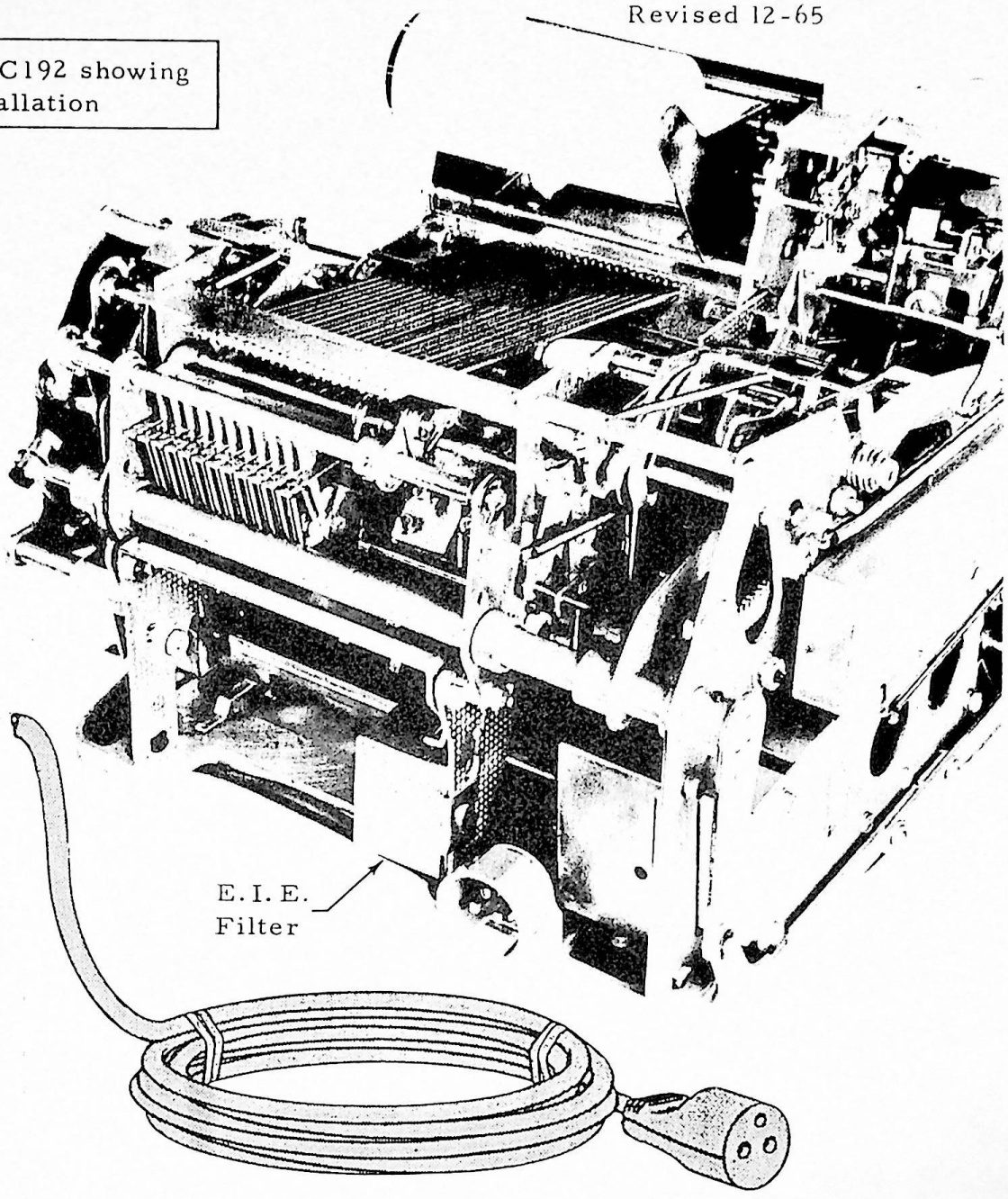


9. Remove the wire nut (L-19004), which connects the red motor lead to the switch lead, and connect the red wire from terminal #4 of filter to the other wires at this point. Re-install the wire nut. Check that all wiring is clear of moveable parts.



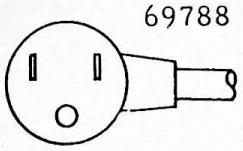
Revised 12-65

Rear View of 211PC192 showing E.I.E. Filter Installation



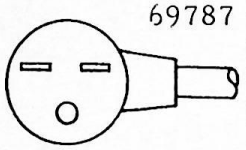
Three-Wire Motor Cords (shown $\frac{1}{2}$ actual size)

69788

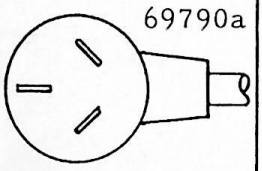


Note: This is the most commonly used 3-wire cord.

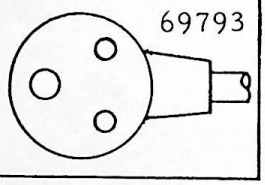
69787



69790a



69793

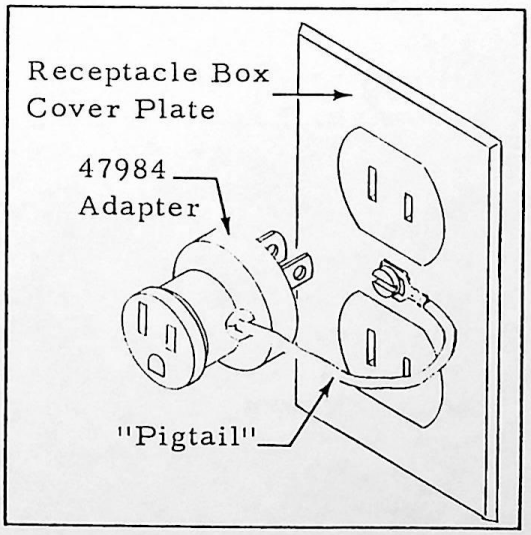


IMPORTANT NOTE:

A THREE-WIRE MOTOR CORD MUST ALWAYS BE USED WITH E.I.E. EQUIPPED MACHINES.

The chart above shows the various style three-wire cords available for use with the standard motor plug on PC-1421 model machines.

In the event the machine is to be used in an installation that does not have provision for a 3-prong plug, a 47984 adapter should be used with the 69788 cord shown above... provided the receptacle box is properly grounded. Make certain the "pigtail" lead of the adapter is secured to the cover plate screw of the box.



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Supplement of 9-24-65
Revised 3-30-66

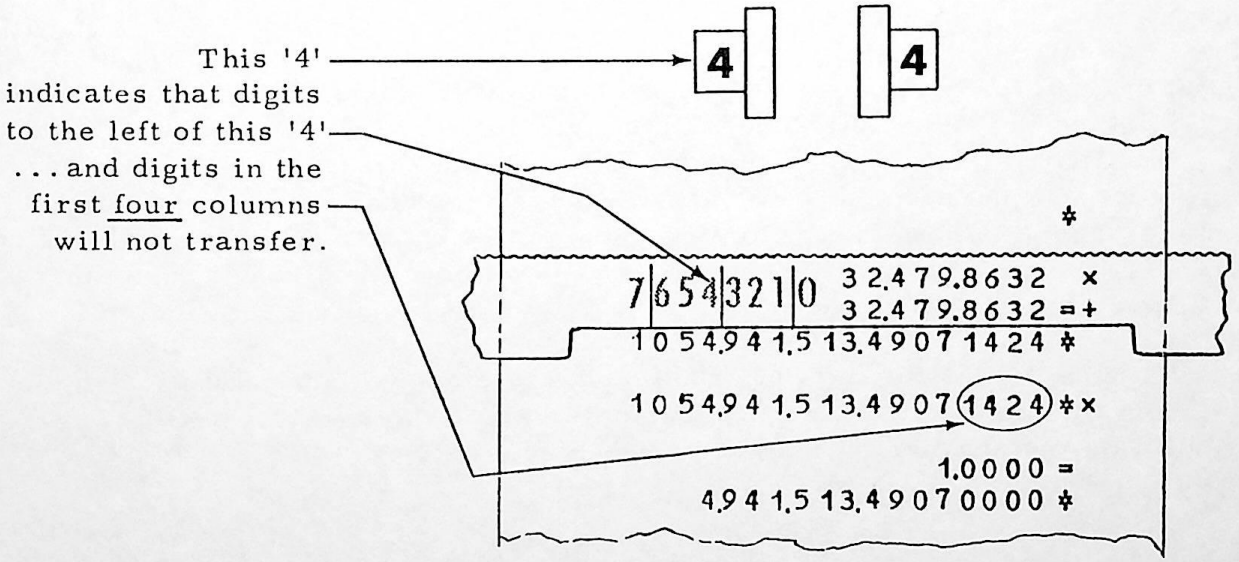
This revised supplement is being released to acquaint servicemen with a change in the material used in the various line finders listed. The information contained in the original supplement has been corrected to eliminate certain erroneous references and is also included herein. Please insert this revised supplement in place of the original supplement in your copy of C.S.B. #P2-502. The original supplement of 9-24-65 should be removed from your copy and destroyed.

REVISED TEAR-OFF LINE FINDER

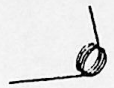
Two revisions have been made on the line finder for the 211PC192 model: A section of the lower edge has been removed to provide for easier reading of results. A group of engraved digits have been added (in turquoise) on the left side of the line finder.

The material used in the line finders for both the 211PC192 and the Epic has been changed to a stronger "crystal clear thermoplastic polystyrene" to eliminate breakage of these parts. This change was made because 461-S reports from the field indicated the necessity for such a revision.

The purpose of the engraved digits is to give the operator a means of determining if any high order digits will be dropped during a multiplication transfer. The digits on the line finder correspond to the digits on the left decimal selector. If, for example, the left decimal selector is set at 4, any amount that is under the 4 on the line finder, or to its right (up to a total of eleven columns), will be transferred; any digits either to the left of the 4, or in the first <u>four</u> right end columns will be dropped.



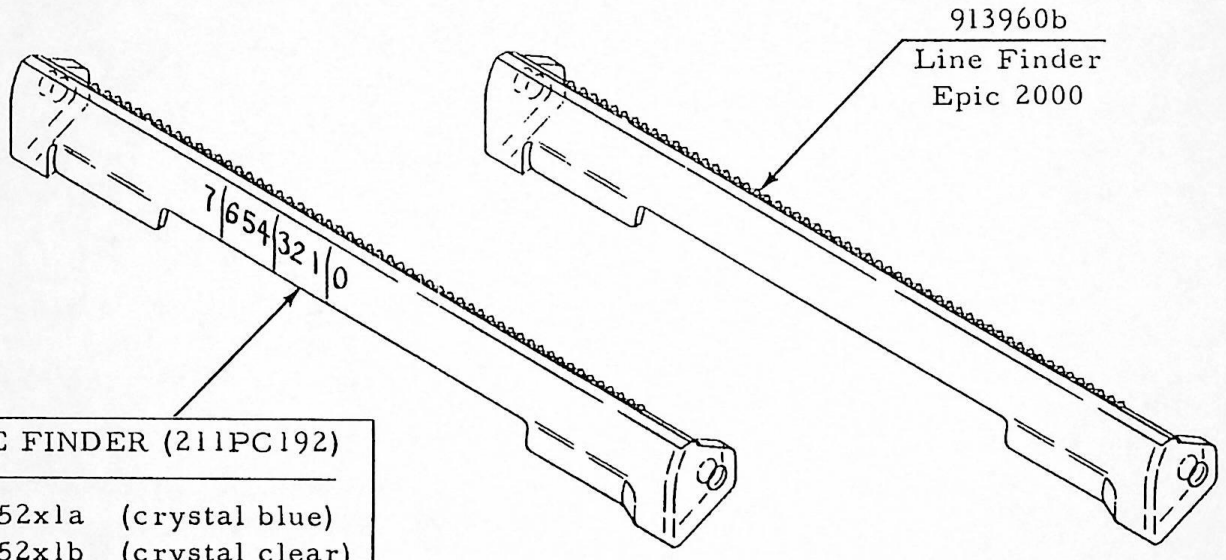
The torsion spring for the line finder has also been revised. It has been made stronger (by increasing the wire diameter from .014 to .015) to insure full opening of the line finder for paper insertion.



913803a
Spring

The engraved line finder and torsion spring have been included in all 211PC192 machines since the production of serial number B693397.

It is not necessary to update previous machines with these parts....However, the parts are available on requisition from Orange for replacement purposes.



LINE FINDER (211PC192)	
913952x1a	(crystal blue)
913952x1b	(crystal clear)

NOTE: In an interim revision, a group of the subject line finders was made of "crystal blue thermoplastic polystyrene". These parts were identified as 913952x1a (211PC192) and 913960a (Epic 2000). This material, while equivalent in strength to the "crystal clear", has a slight bluish tint. When the Sales Department expressed a preference for the untinted material, the succeeding change to "crystal clear" was made. There is however, a limited supply of 913952x1a (blue tinted) line finders for the 211PC192 model only, available on requisition in the event a customer specifically requests this type.

NOTE: The line finder for the Epic 2000 model is also available, and it can be used on 211PC192 machines in the event a customer wants the lower edge cut away...but does not want the engraved digits.

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Supplement of 9-24-65

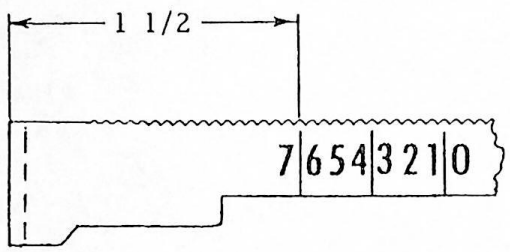
Please insert this supplement following
Page VI-D-16 in your copy of C.S.B. #P2-502.

REVISED TEAR-OFF LINE FINDER

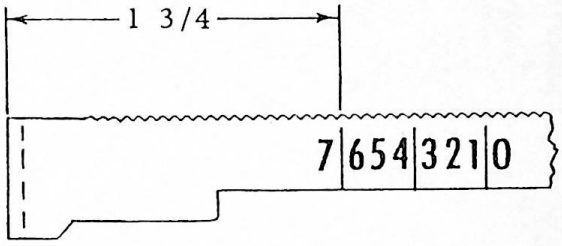
Two revisions have been made on the line finder for the 211PC192 model: A section of the lower edge has been removed to provide for easier reading of results. Also, a group of engraved digits have been added (in turquoise) on the left side of the line finder.

The line finder for the 211PC172 model also conforms to the above description... except that the engraved digits are located two columns further to the right than on the 211PC192 line finder.

ENGRAVED LINE FINDER IDENTIFICATION GUIDE

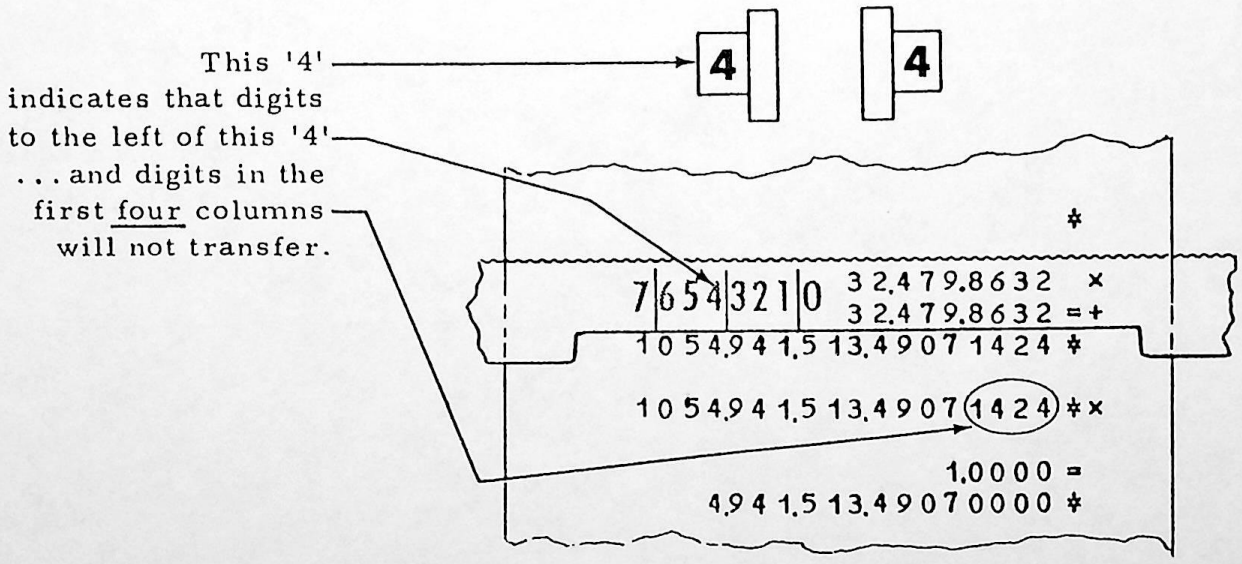


913952x1
211PC192 (PC-1421) Model

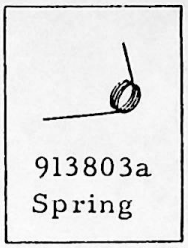


913961
211PC172 (PC-1417) Model

The purpose of the engraved digits is to give the operator a means of determining if any high order digits will be dropped during a multiplication transfer. The digits on the line finder correspond to the digits on the left decimal selector. If, for example, the left decimal selector is set at 4, any amount that is under the 4 on the line finder, or to its right (up to a total of eleven columns), will be transferred; any digits either to the left of the 4, or in the first four right end columns will be dropped.



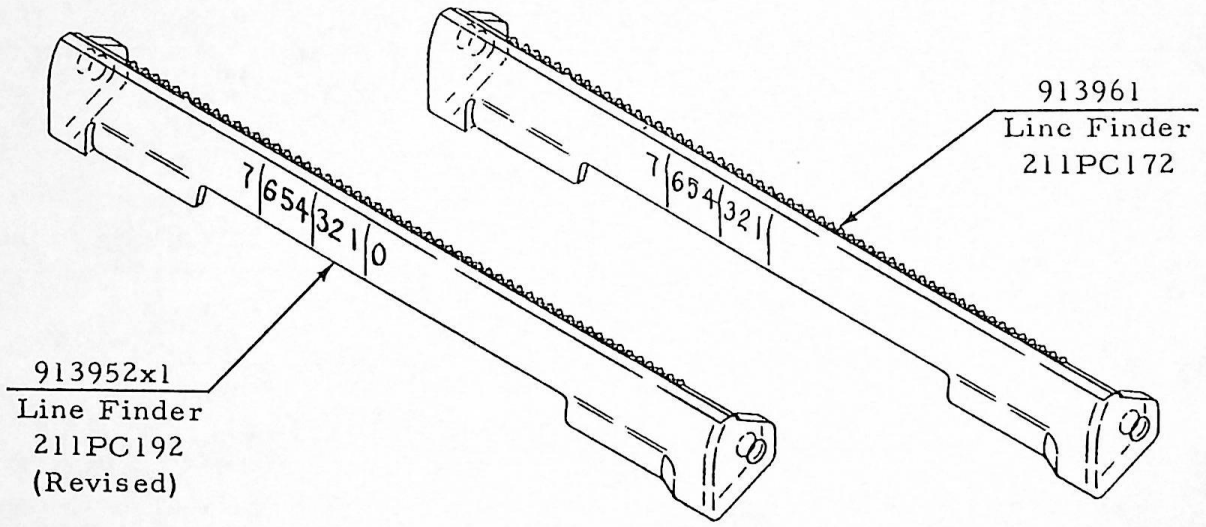
The torsion spring for the line finder has also been revised. It has been made stronger (by increasing the wire diameter from .014 to .015) to insure full opening of the line finder for paper insertion.


913803a
Spring

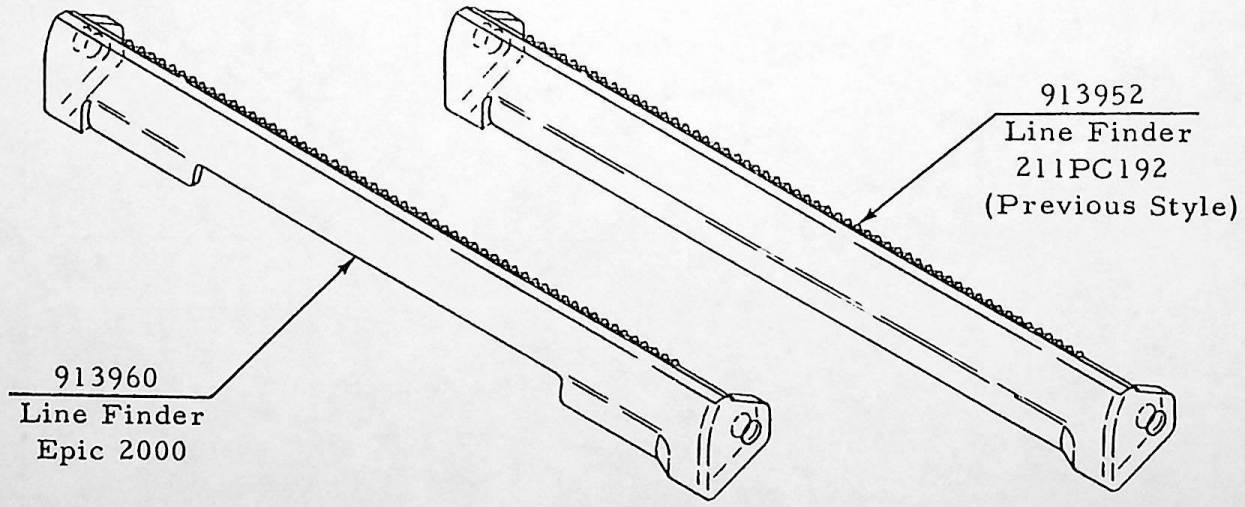
The engraved line finder and torsion spring will be included in all 211PC172 machines beginning with the first such machine produced.

The engraved line finder and torsion spring will be included in all 211PC192 machines beginning with serial number B693397.

It is not necessary to update previous machines with these parts....However, the parts are available on requisition from Orange for replacement purposes.



NOTE: The line finder for the Epic 2000 model is also available, and it can be used on 211PC192 and 211PC172 machines in the event a customer wants the lower edge cut away...but does not want the engraved digits. The previous style line finder for the 211PC192 will also remain available (while the supply lasts) for those who do not want the cut away section on the lower edge.



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Supplement of 11-19-65

Please insert this supplementary page in proper sequence in your copy of C.S.B. #P2-502.

IMPROVED* DECIMAL CORDS

The material used in the decimal selecting slide positioning cords has been changed to a material with less stretch. This has been done to reduce the frequency of adjustment necessitated by the stretching of the previous style cord.

The new material is red in color...which makes the revised cords readily distinguishable from the black previous style.

Changed parts:

97-916b (red) replaces 97-916a (black)	Left side cord (1 used)
97-917b (red) replaces 97-917a (black)	Right side cord (2 used)

Note: 97-916b also replaces 97-916a in the Input-Output unit of Epic 2000 models.

The 97-916b and 97-917b improved (red) cords will be included in 211PC192 machines beginning with serial number B-694705.

* Please note that this change is an interim improvement....Our Research Department is presently testing material that has even more stable characteristics than the red material. It is expected that a change to this "more stable" material will be forthcoming soon. It is therefore, recommended that Branch Service Departments do not engage in any wholesale replacement of black cords with red cords. The red cords however, are available on requisition...they are definitely superior to the black cords...and they should be used whenever normal replacement is required, until such time as you are notified that a further improvement has been released.

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Supplement of 2-25-66

Please insert this supplementary page in proper sequence in your copy of C.S.B. #P2-502.

IMPROVED DECIMAL CORDS

The material used for the decimal selecting slide positioning cords has been changed to a material with more stable characteristics. This has been done to eliminate stretching of the cord and the resultant necessity of re-adjustment.

The new material is white in color...which makes it readily distinguishable from both the original black cord and the interim red cord (described on the preceding page).

Changed parts:

97-916c (white) replaces 97-916b (red) left side cord (1 used)
97-917c (white) replaces 97-917b (red) right side cord (2 used)

The 97-916c and 97-917c cords (white) will be included in all PC machines beginning with serial no. B-882922

It is not necessary to update all field machines with the new cords....However, any machines with a continuing history of decimal cord re-adjustment should have the new cords installed.

Field stock of the original black cords should be returned for credit or even exchange. Refer to "C.S.B. #P2-502, Supp. of 2-25-66" on requisitions sent with returned cords.

THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

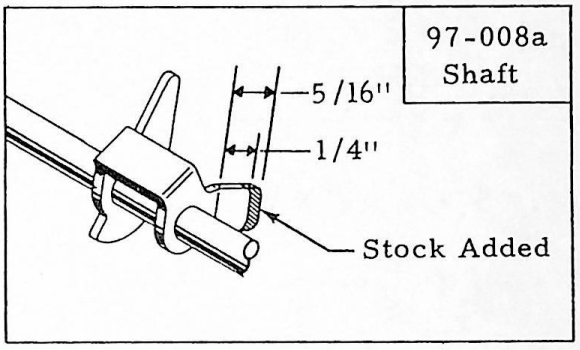
Supplement of 2-14-66

Please insert this supplement (pages VI-D-21 thru VI-D-23) in proper sequence in your copy of C.S.B. #P2-502.

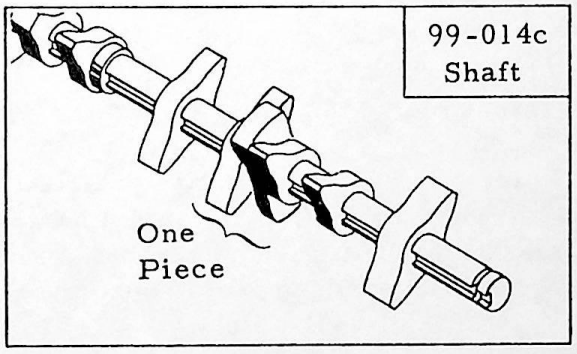
IMPROVED DECIMAL ACTUATOR ARM SHAFT

IMPROVED MULTIPLIER PROGRAM CAM SHAFT

The length of the camming extension on the cam bail of the decimal actuator arm shaft has been increased to eliminate the possibility of a "point to "point" condition between the intermediate arm and cam bail (refer to page V-D-14 for functional description).

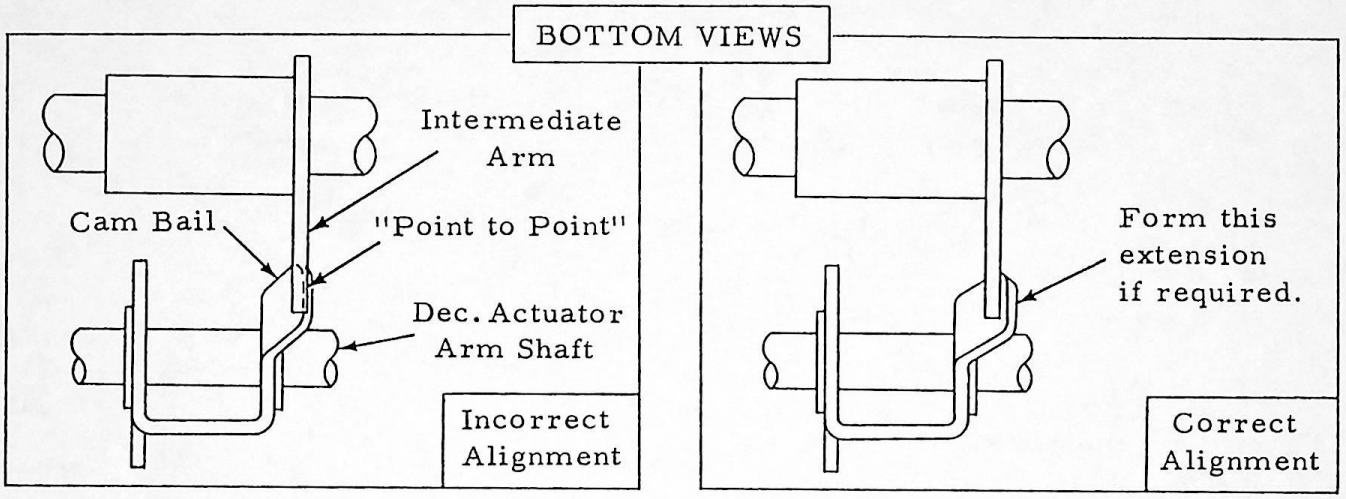


The three cams on the multiplication program cam shaft which operate program slides #7, #8 and #9 are now being molded in a one piece cluster. (Previously they were three separately molded pieces). This change has been made to provide additional strength to the cam which operates program slide #8 (Enter Multiplier).



97-008a Decimal Actuator Arm Shaft replaces 97-008.
99-014c Mult. Program Cam Shaft replaces 99-014b.

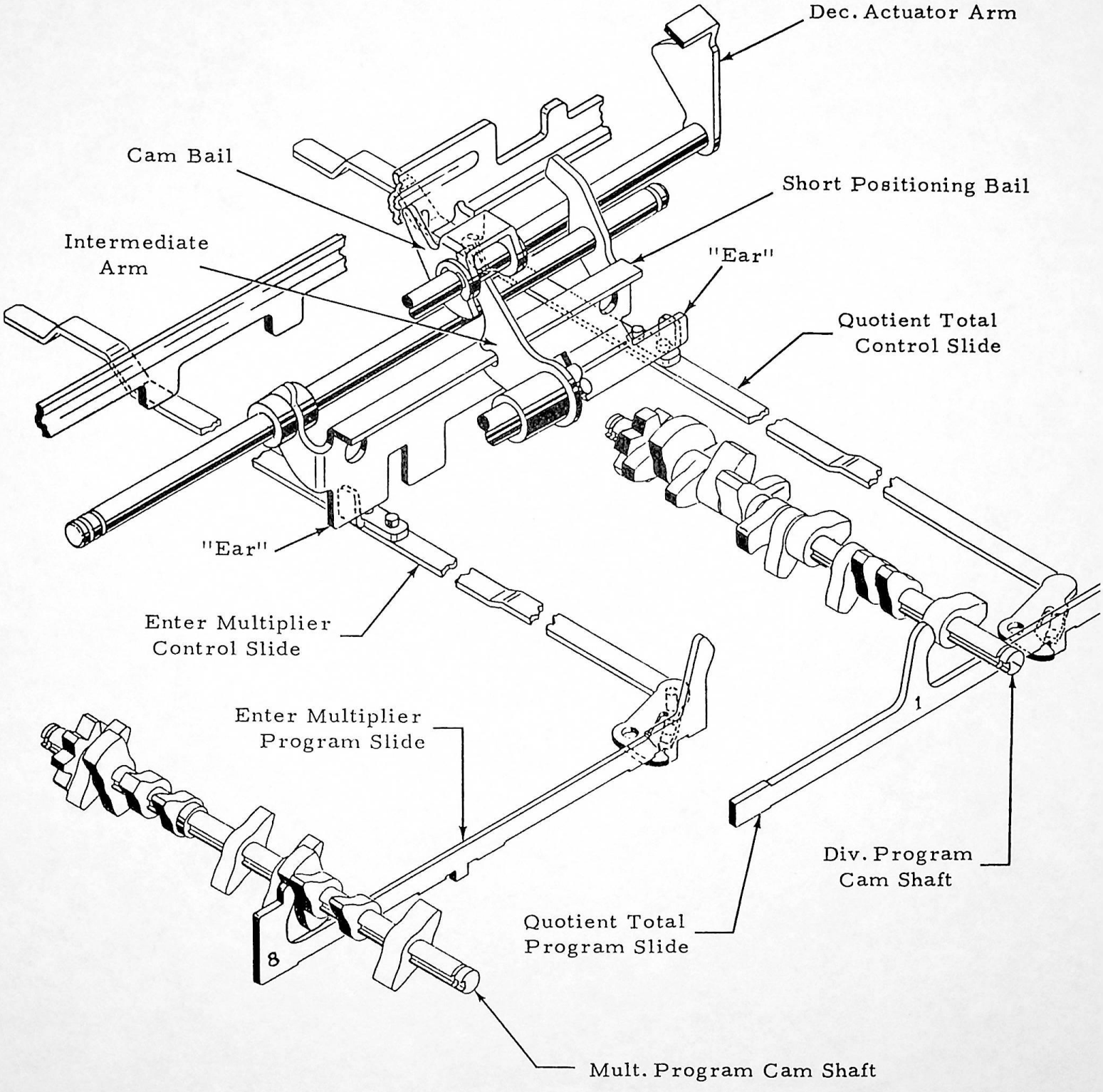
These revisions have been made at the request of Statistical Quality Control and result from their continuing study of 461-S Service Record reports from the field. Some such reports have indicated a tendency to fracture the above mentioned cam . . . and the primary cause of this was a slight mis-alignment which resulted in the "point to point" condition.



The two revised assemblies will be included in all "PC" machines beginning with serial no. B882720. Please note: It is NOT necessary to update field machines with these parts. . . . However, whenever checking-out or performing an inspection on a machine with a serial no. prior to the one above, look for a potential "point to point" condition between the cam bail and intermediate arm. The camming extension of the cam bail may be formed upward slightly if necessary. If this is done, check the alignment of the actuator arms with the lower decimal selecting bar (V-D-15). . . first with the enter multiplier control slide activated (hand crank mult. operation) . . . then with the quotient total control slide activated (hand crank div. operation). The "ears" of the short positioning bail may also have to be formed to obtain sufficient movement of the actuator arm shaft.

Note: If further adjustment is required, the intermediate arm (page V-D-14) or the rearward extension of the cam follower shown on page V-B-14 may also be formed slightly. If either of these two parts are formed, check to see that the dec. actuator arms still align properly with all three dec. selecting bars (as illustrated on page V-B-14 and V-D-15).

If a fractured "enter multiplier" cam is encountered. . . first check for the point to point condition or any other binds, harsh action or interference with the enter multiplier programming mechanism. . . correct any such trouble. . . then install a revised mult. program cam shaft (99-014c). Previous style mult. program cam shafts in field stock should be returned for credit or even exchange. Reference to "C.S.B. #P2-502, Supp. 2-14-66" should be made on requisitions sent with returned shafts.


Dec. Actuator Arm
Cam Bail
Short Positioning Bail
Intermediate Arm
"Ear"
Quotient Total Control Slide
"Ear"
Enter Multiplier Control Slide
Enter Multiplier Program Slide
1
Div. Program Cam Shaft
Quotient Total Program Slide
8
Mult. Program Cam Shaft

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Supplement of 3-8-66

Please insert this supplement page in proper sequence in your copy of C.S.B. #P2-502

IMPROVED DUST COVER

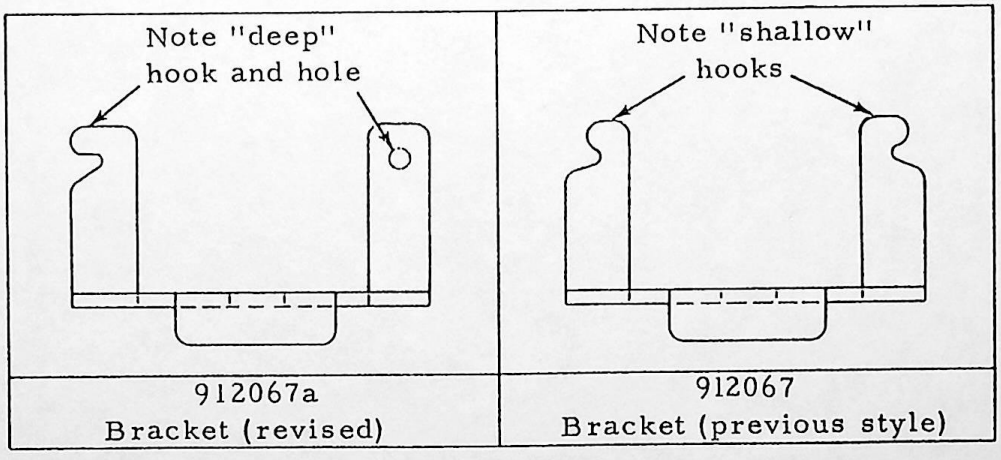
The material used in the CC-9 dust covers for PC machines has been changed from vinyl to a clear polyethylene. This has been done to eliminate the possibility of damage to painted sections of the cover case. It has been found that the vinyl covers...under certain time, temperature and humidity conditions ...can "migrate" into the air-dry lacquer finish on the case and cause such damage. (The part most affected has been the dark gray upper rear cover case section...part no. 912-901e).

The new clear polyethylene dust covers are available on requisition from Orange. Field stock of the previous vinyl dust covers may be returned for even exchange. Refer to "C.S.B. #P2-502, Supp. of 3-8-66" on requisitions sent with returned vinyl covers.

IMPROVED SPRING BRACKETS FOR COVER CASE

The contour of the terminals on the spring brackets for the cover case has been revised to prevent the springs from popping off when the keyboard cowl or rear cover are removed. The revisions are shown on the drawing below. The revised brackets are available on requisition from Orange.

912067a Cover Case Spring Bracket replaces 912067



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Supplement of 6-30-66

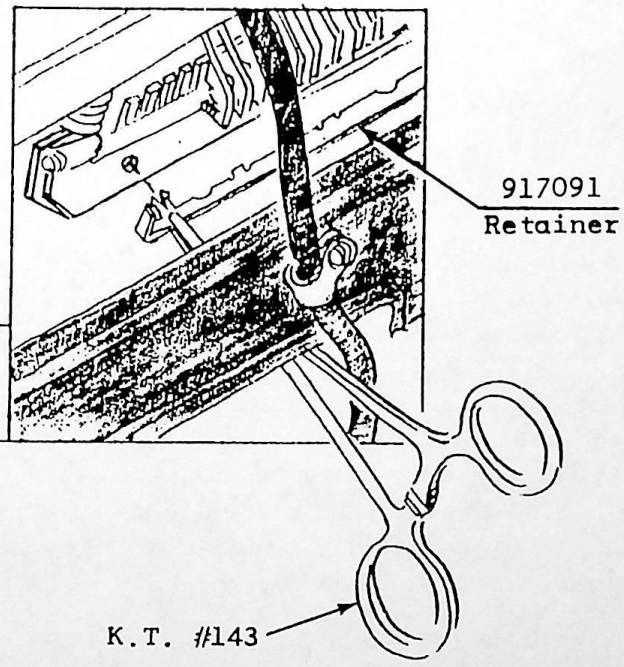
Please insert this supplement (pages VI-D-25 thru VI-D-32) in proper sequence in your copy of C.S.B. #P2-502.

RETAINER FOR ALIGNER PAWL SPRINGS
(Ref. C.D. P-787)

This new retainer, part no. 917091, is available on requisition for installation on both Epic and PC machines. Servicemen should check the aligner pawl springs whenever performing a maintenance inspection or new machine checkout... and install the new retainer on all machines in which any of the springs appear distorted or out of their proper position.

To install: With line cord removed, depress plus key ... Touch line cord to plug just enough to turn main shaft to approximate half cycle position. Turn machine upside down and remove access pawl from bottom cover section. Grasp retainer near left end with K.T. #143 and place in position so that self-locking tabs align with unused holes in aligner frame (as illustrated). Push into left hole until retainer is fully seated. Align right tab with right hole and gently tap into fully seated position with the blade of a screwdriver. Check pawl springs for proper action and position. Neutralize main shaft.

Installation of this retainer is production machines began with serial no. B-883542.



NOTE: Sketch shows installation of retainer in Epic 2000 printer. Installation in PC models is very similiar.

REVISED CARRIAGE RETURN CORD & INTERIM CORD RETAINER

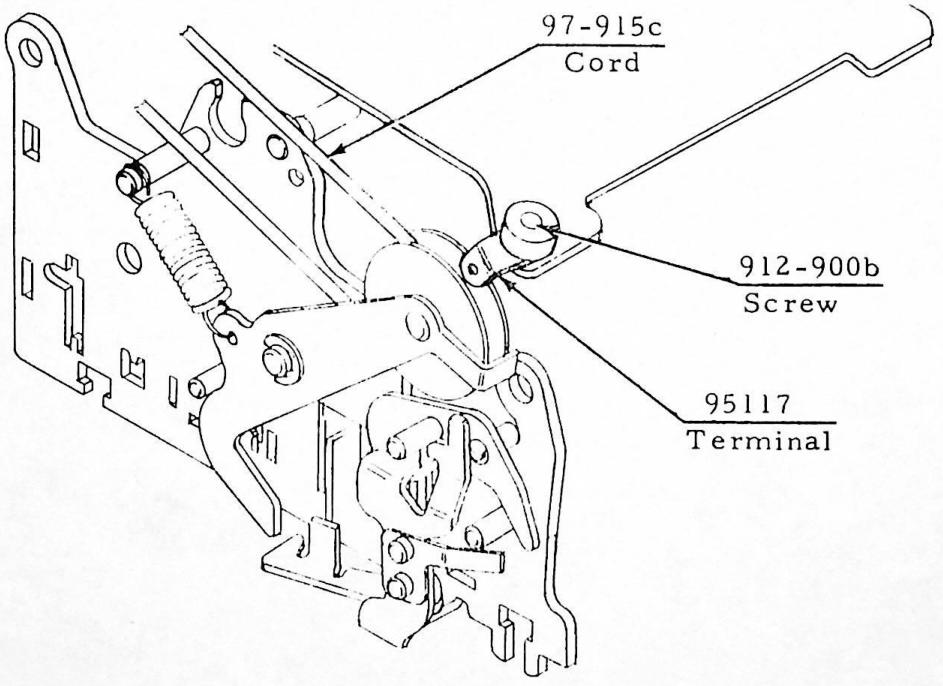
(Ref. C.D. P-788 & M-723, SH.-414)

97-915c cord replaces 97-915b.

95117 terminal replaces 2832 washer (interim change).

The material used for this carriage return cord has been changed to a "Silicone treated pre-stretched Dacron" to overcome stretching and the resultant necessity of re-adjustment. The 97-915c revised cord is white. The previous style 97-915b is black.

NOTE: The increased flexibility of the revised cord has made it necessary to add another guide lug to the front pulley arm to prevent the cord from jumping off the top half of the pulley during repeat plus or minus operations. This change is presently in process and parts are not available at this time. However, as an interim means of retaining the cord, a stock spring terminal (95117) is being installed in place of the spacing washer (2832) under the 912-900b front cushion screw of the left control keyboard.



The revised cord should be installed in all machines having a history of return cord re-adjustment. The 95117 terminal should be installed whenever the revised cord is used (until such time as the new front pulley arms are available).

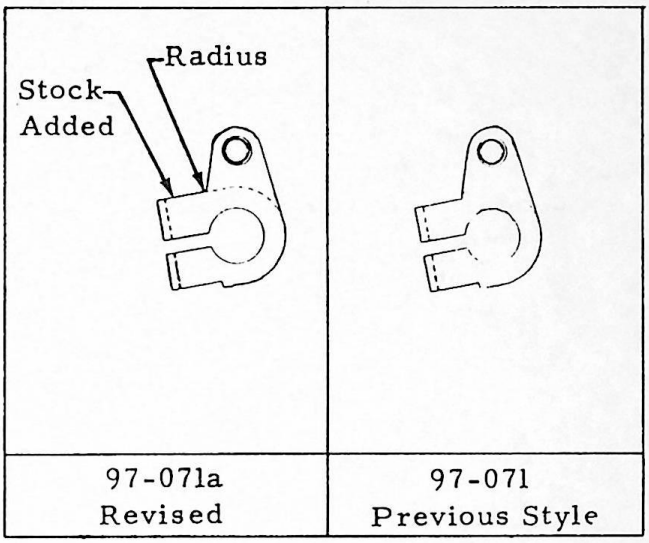
NOTE: Check for cord jumping off by performing a series of repeat plus operations with no entry in set-up carriage and dec. knobs set for totals of 9, 10, 11, 12, 13, and 14 decimals. Carefully position (and form, if necessary) the 95117 terminal to prevent cord from jumping off. The terminal should provide maximum guarding of pulley groove while still permitting the assembly to pass freely when rocked rearward.

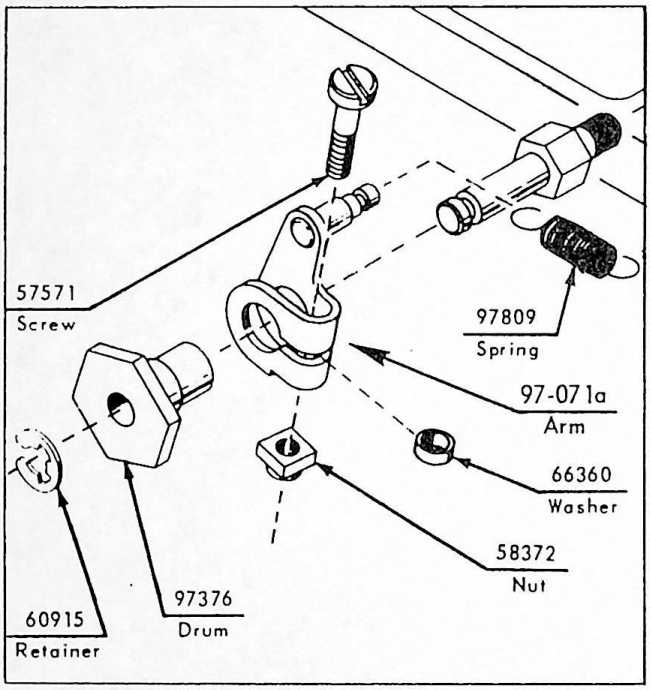
REVISED CABLE DRUM CLAMP ARM

(Ref. C.D. P-733)

97-071a cable drum clamp arm replaces 97-071.

To eliminate fracturing of this arm, the sharp corner has been changed to a radius (see illustration) and more stock has been added to the upper section of the clamp.



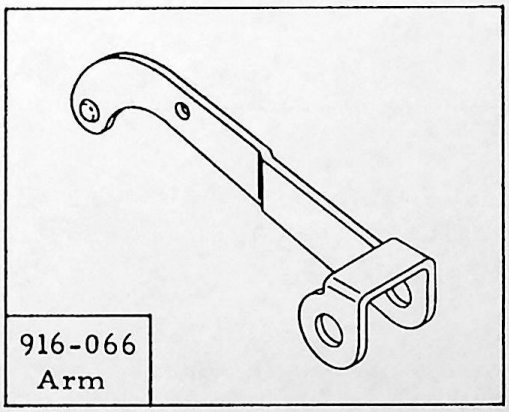


The revised arm (97-017a) is now being installed in all production machines. All field machines which do not have it, should be updated on the next service call or maintenance inspection.

NOTE: The 66360 spacing washer MUST still be used between the jaws of the clamp.

HARDENED DIV. SEQUENCE SHAFT DETENT ARM

Difficulties with proper detenting of the Division sequence cam shaft (916-008c) have been traced to a group of upper detent arms (916-066) which were not case hardened. The starting serial number of machines produced with soft 916-066 detent arms is not known. When the condition was dis - covered, installation of properly hardened arms resumed with serial no. B-883501. Therefore, servicemen should file test the upper detent arm whenever servicing or inspecting a machine with a prior serial number... and replace any soft arms encountered.

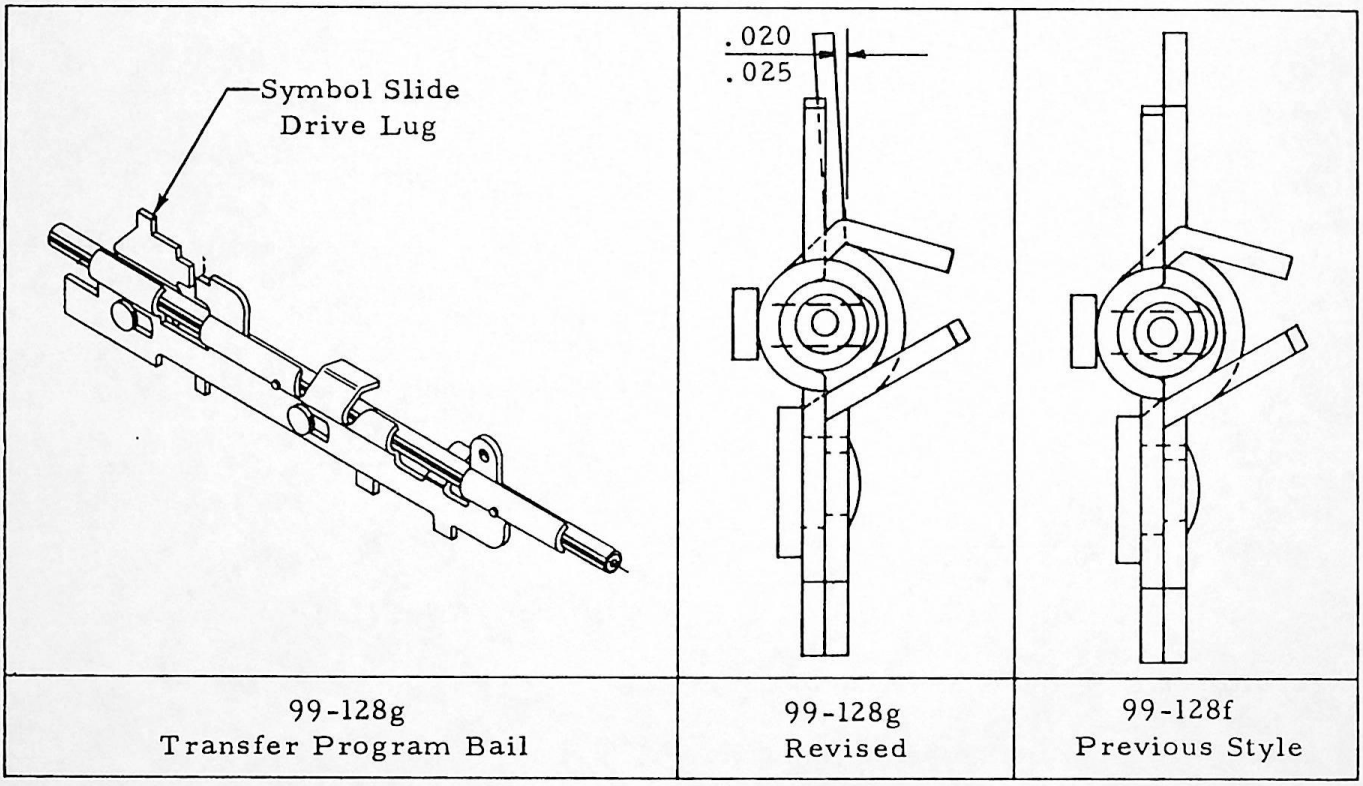


IMPROVED TRANSFER PROGRAM BAIL

(Ref. C.D. P-774)

99-128g transfer program bail replaces 99-128f

To eliminate a critical timing condition, which could sometimes result in engagement of the wrong set of accumulator gears when transferring a negative amount, the position of the symbol slide drive lug on the transfer program bail has been changed. The lug is now located .020-.025" further to the left. This will delay the movement of either the neg. total/total or the neg. sub-total/sub-total symbol slides to the right ... thus allowing more time for the red-print credit balance program control slide to move forward into its blocking position (ref. page IV-I-3).



99-128g Transfer Program Bail	99-128g Revised	99-128f Previous Style

Installation of the improved 99-128g transfer program bail in production machines began with serial no. B-883721.

Servicemen should check for this condition on prior machines by performing a series of transfer operations ... with a negative accumulator ... and a plus key depression between each transfer. The symbol slide drive lug on the transfer program bail should be formed slightly to the left on any machines which do not pass this test. Exercise extreme care when forming this hardened lug to avoid fracturing.

REVISED DECIMAL CORD LENGTHS

(Ref. C.D. P-812)

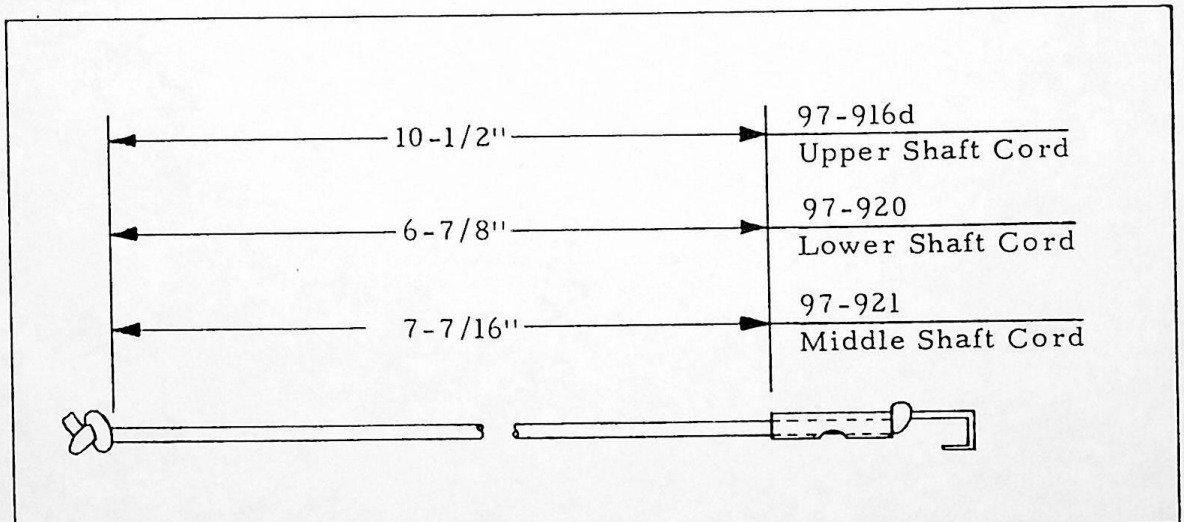
97-916d left side cord (for upper shaft) replaces 97-916c.
97-920 right side cord (for lower shaft) replaces 97-917c.
97-921 right side cord (for middle shaft) replaces 97-917c.

The decimal cords have been shortened to prevent them from overlapping themselves on their pulleys ... thus affecting calibration of the decimal settings. The two cords used on the right side, which were formerly the same length, are now different lengths ... to achieve this prevention of overlap ... and therefore they now have different part numbers.

Installation of the shortened cords in production machines began with serial no. B-884850.

ALL FIELD MACHINES PRIOR TO THIS SERIAL NUMBER SHOULD BE UPDATED WITH THE SHORTENED CORDS ON THE NEXT SERVICE CALL OR MAINTENANCE INSPECTION.

In the event that shortened cords are not readily available, Branch stock of the previous cords (the WHITE cords only) can be converted by knotting to the proper lengths as shown in the drawing below. Apply glue to knot to prevent it from opening.



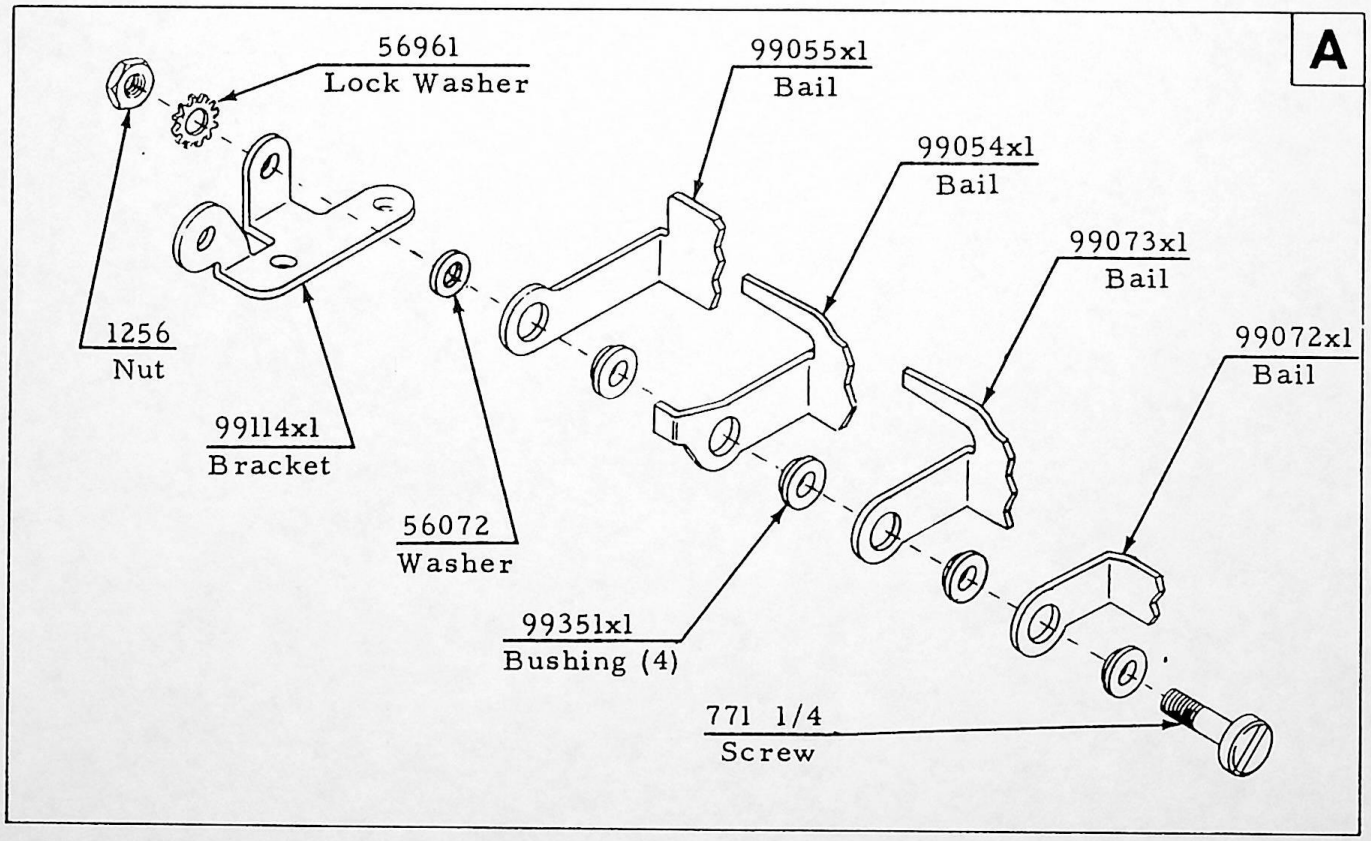
IDENTIFICATION GUIDE - REVISED DECIMAL CORDS

CHANGED ZONING CONTROL OF ACCUMULATOR AND REGISTER CONTROL BAILS FROM RIGHT TO LEFT SIDE

(Ref. C.D. P-732 & P-797)

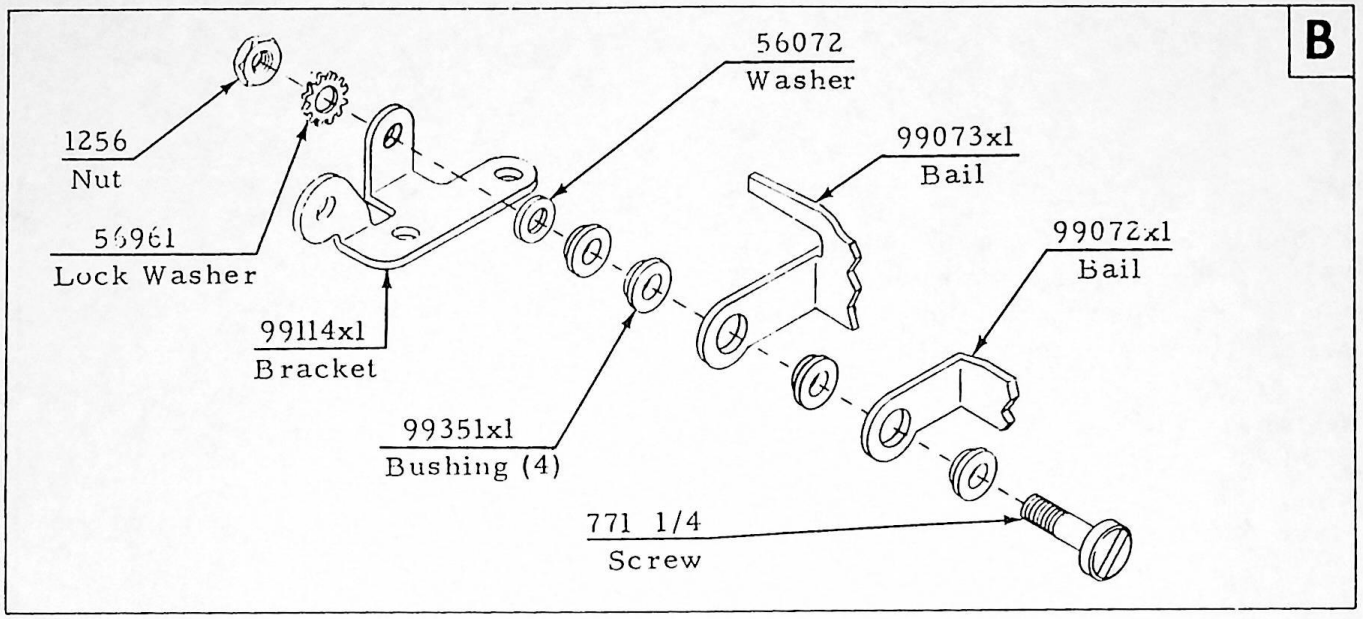
771 1/4 Screw (2 used) replaces 13 and 59595
56072 Washer (2 used) added
99054x1 Acc. total control bail replaces 99054d
99055x1 Acc. plus & minus control bail replaces 99055b
99072x1 Ent. register & ent. multiplier control bail (2 used) replaces 99072b
99073x1 Reg. total & quotient total control bail (2 used) replaces 99073b
99114x1 Control bail bracket (left side, 2 used) replaces 99-053 &99-114
99351x1 Control bail bushing (8 used) replaces 99351
99-050x1 Control bail bracket (right front) replaces 99-050
99-051 Control bail bracket (right rear) replaces 99051

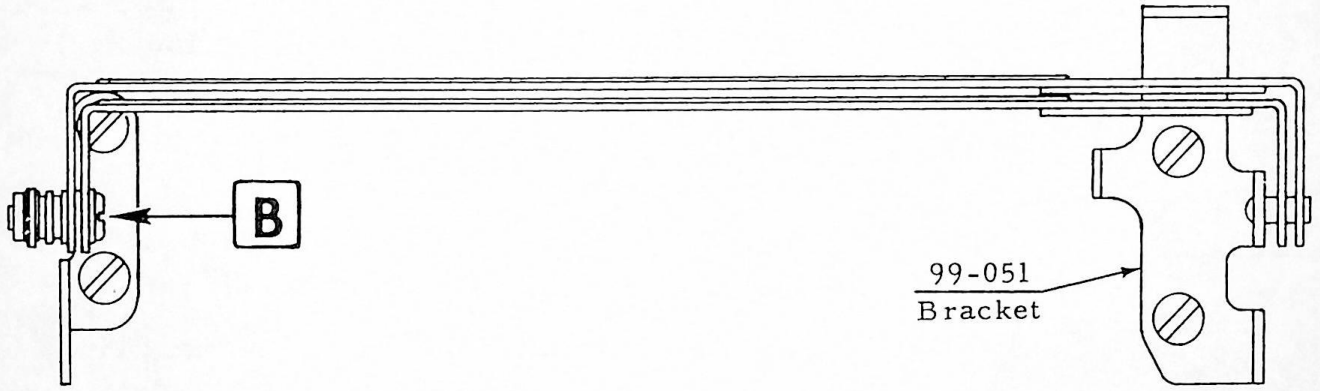
The spacing bushings which control the lateral zoning of the accumulator and register control bails have been revised and moved from the right side of the machine to the left side. This was done to provide zoning control at the point where it is most important for operation of the minus control bail with the overdraft total mechanism and bail. With the previous zoning control on the right side, and the left ends of the bails riding freely on a stud, the accumulator total control bail could flex enough to make its adjustment in relation to the minus control bail rather critical. Difficulty in this area was found to be a primary cause of re-adjustment of the accumulator drive arm (94-068). With the zoning control now on the left side, this condition should be greatly improved.

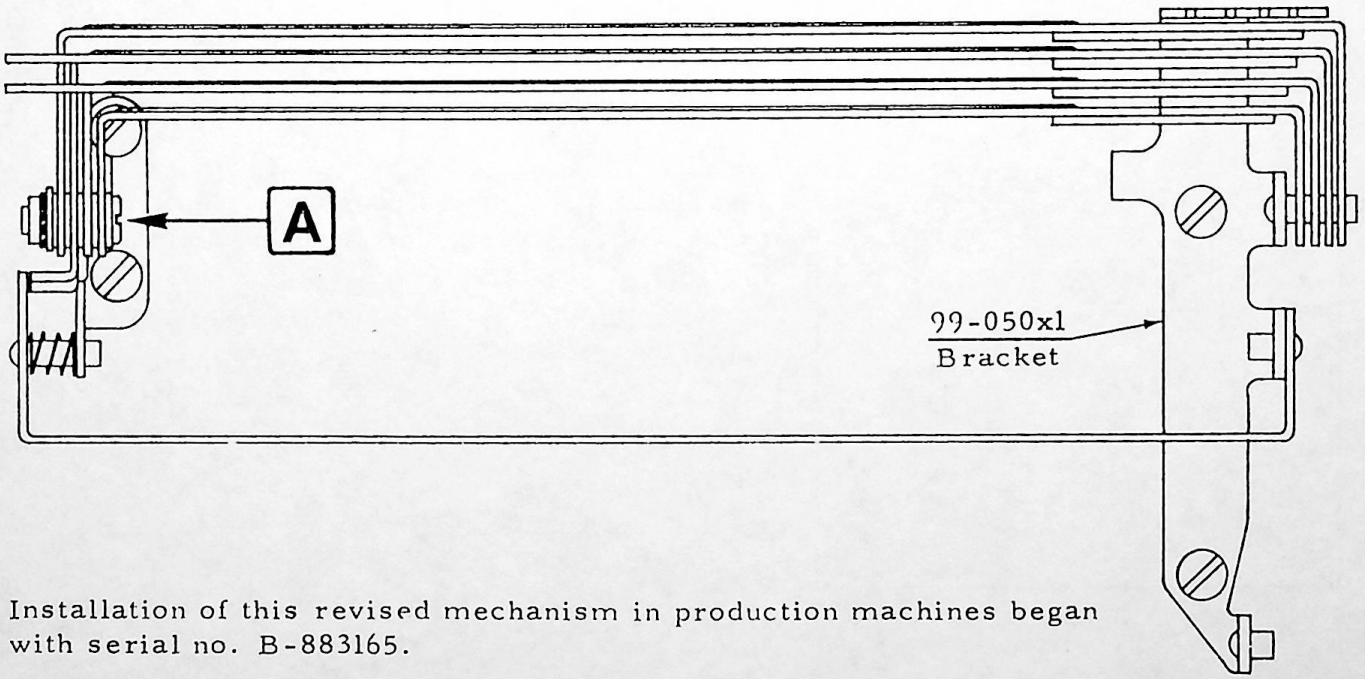


NOTE: The width of the flanges on the control bail bushings has been reduced to maintain the same lateral alignment of the control bail operating surfaces as was present previously.

NOTE: Since two of the affected bails are also used at the rear of the machine (enter multi plier and quotient total) the zoning control of these bails was also moved from the right to the left side. This was done to facilitate production and it is not a functional improvement.







Installation of this revised mechanism in production machines began with serial no. B-883165.

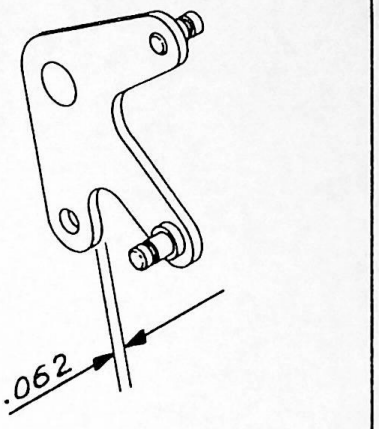
IMPROVED PROGRAM CAM FOLLOWER

(Ref. C.D. P-798)

911-056a cam follower replaces 911-056

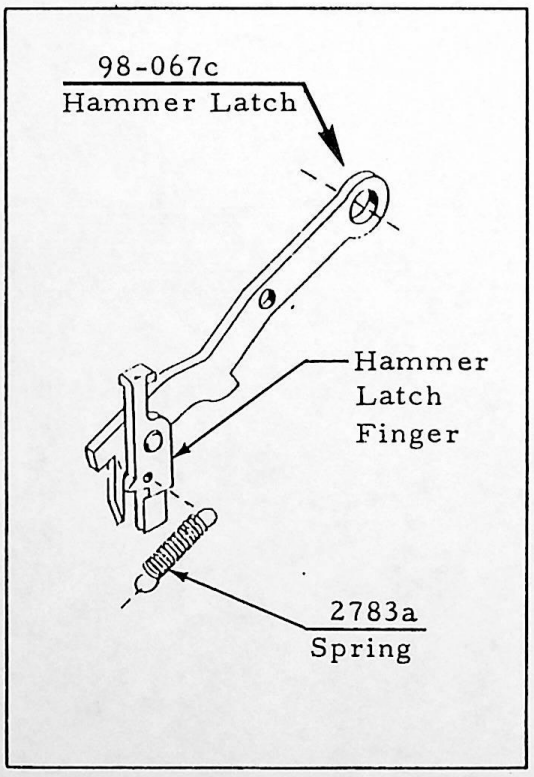
The stock thickness of the program cam follower has been changed from .040 to .062. This has been done to eliminate the possibility of the roller arms twisting and the resultant necessity of re-adjustment.

Installation of the improved cam follower in production machines began with serial number B-885095. It is not necessary to update field machines with this part. However, if it becomes necessary to replace the program cam follower in any field machines, always use the improved part.



911-056a (Revised)

SPECIAL HAMMER LATCH FINGER SPRINGS



Incidents of occasional failure to print the high order digit of an amount have been reported on 461-S Service Record Forms. This trouble has been traced to a slightly rounded latching surface on the hammer latch finger which can permit the finger to slide off the edge of the raising bail (98-113). The problem can be corrected by installing a stronger spring on the latch finger. The 2783a springs used can be made strong enough by removing four (4) loops from the end ... then re-forming the end loop. Strenghtened springs should be used only in columns where print failure has occurred.

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Printed In U.S.A.

Supplement of 2-14-67

Please insert this supplement (Pages VI-D-33 thru VI-D-41) in proper sequence in your copy of C.S.B.#P2-502.

A number of quality and reliability improvements are presently being incorporated in 211PC192 and 211PC193 machines in production. This release is to advise you of these improvements, describe them briefly and let you know whether or not, or to what extent, updating of Field machines is recommended.

Those improvements which affect part numbers will also be covered, and illustrated as required, in forthcoming supplements to the Parts Catalog (C.S.B.#P2-501).

Note: A "starting serial number" is provided with each of the improvements described. This is not necessarily the first machine in which the improvement is included....It is the first number after which you can be certain that <u>every</u> machine produced will contain the improvement. In many instances there will be several hundred machines with prior serial numbers which will have been updated with the subject improvement in production.

Another means which may be helpful in identifying improved machines is the date....<u>All</u> machines "booked-out" of production after 2-8-67 will contain all of the improvements listed in this release (No. 1 thru No. 19).

No.1 Main Cam Shaft/Cam Follower Shaft Brace

A stiffening brace which directly connects the main cam shaft to the cam follower shaft, near the center of the machine, is being added to eliminate "flexing" and thereby provide greater stability between these shafts.

Revised parts:

911-002x6	Main Cam Shaft
911011	Bearing (new part)
97-101x1a	Dec. Intermediate Arm

Installation in production machines began with serial no. B-980353.

This change is NOT to be installed in field machines unless it becomes necessary to replace the main cam shaft. If this is done, then the improvements to the hold-up mechanism (described under No. 6 and No. 7 in this release) and the improvement in the decimal actuator mechanism (described under No. 17 in this release) must also be installed.

No. 2 Improved Plus Positioning Link

Stock has been added behind the lug on top of the plus positioning link to eliminate the possibility of the accumulator positioning latch (94-063c) being caught behind this lug.

Revised parts: 94085x1a Plus Positioning Link

Installation of the improved link in production machines began with serial no. B-980272.

Improved links MUST be installed in all machines in Branch stock before delivery to a customer....Updating of customer machines, at the convenience of the Branch, is recommended as a reliability improvement.

No. 3 Strengthened Hammer Restoring Bar

Stock has been added to the hammer restoring bar to eliminate the possibility of the bar "bowing"...which could result in print failure.

Revised parts: 98053b Hammer Restoring Bar

Installation of improved restoring bars in production machines began with serial no. B-976391.

Improved bars MUST be installed in all machines in Branch stock before delivery to a customer....Customer machines should be updated on the next service call or maintenance inspection.

No. 4 Tab. Belt Replaced by Rack and Pinion

The timing belt of the transfer decimal tabulator mechanism has been replaced by a rack and pinion gear mechanism. This will eliminate binding of the decimal shafts and the critical nature of the auxiliary hold-up trip spring adjustment.

Revised parts:

97-147x1	Latch for 1/2 Cent Decimal Sensing (211PC193 only)
97148	Tab. Rack (new part)
97970x1	Rear Gear for Tab Rack
97969x1	Front Gear for Tab Rack
916006x1	Shaft
916-075x1	Bail

Installation of this improved mechanism in production machines began with serial no. B-980594.

This mechanism should be installed only in those field machines which have a history of frequent auxiliary trip spring re-adjustment.

No. 5 Revised Carriage Return Cable Drum Arm

The previous style cable drum (97376a) and mercedes clamp arm (97-071a) have been replaced by a single assembly which combines both parts. The carriage return cord has been lengthened for use with the new assembly and it is now secured, by a flat clamp and screw, to the upright arm of the new drum. This has been done to eliminate both the slipping of the previous clamp arm on the drum, which necessitated re-adjustment, and the fracturing of the clamp arm from over-tightening.

New Parts:

97-149	Cable Drum Arm
97150	Flat Clamp
65574	Screw for Clamp
97-915e	Carriage Return Cord
99-124x1	Decimal Bail

Installation of these parts in production machines began with serial no. B-980430.

This change MUST be incorporated in all machines in Branch stock before delivery to a customer....Customer machines should be updated on the next service call or maintenance inspection.... EXCEPTION: As an interim improvement (before the new parts were available) a number of machines were produced with annealed cable drums. These soft drums permitted the clamp arms to get a good "bite" and have proven very satisfactory. (NOTE: A thinner spacer, part no. 66360 Special, was also used, with the annealed drums, between the jaws of the clamp arm). The annealed drums are easily identified by their jetalized (black) finish. It is NOT necessary to update machines which have the annealed drum.

NOTE: A small supply of the annealed drums (97376a Special) and spacers (66360 Special) are available on requisition. These can be used in lieu of the other updating parts while the supply lasts.

No. 6 New Yielding Block Arm on Hold-Up Link

The blocking arm of the hold-up link has been re-designed so that it can yield, under spring tension, in the event a malfunction or misoperation causes the hold-up latch disabling lever to be programmed while the blocking arm is positioned over the lug of the hold-up latch extension arm (96-056). This will eliminate the possibility of forcing the extension arm out of adjustment in such cases.

Revised Parts: 96-079x2 Hold-Up Link
55809 Yield Spring

Installation of these parts in production machines began with serial no. B-980430.

Installation in field machines is NOT recommended unless there is a severe and continuing history of difficulties of the nature described above...or if it is necessary to install the improved main cam shaft (No.1 in this release). If this improved hold-up link is installed, then the improvement described under No. 7 in this release must also be installed.

No. 7 Improved Hold-Up Release Action

The roller, on the arm of the hold-up latch, which operates into a notch in the carriage return cam hub has been replaced by a plastic tip. The notch in the cam has also been re-designed to operate properly with the plastic tip. This has been done to keep the hold-up latch fully positioned for the maximum time and then provide a quick and positive release. This will eliminate the somewhat gradual release which occurred with the roller...and which could result in partial release in mult. transfer operations before the hold-up link had moved fully into blocking position. This change will also contribute further to eliminating the previously critical nature of the auxiliary hold-up trip spring adjustment (See also No. 4 in this release).

Revised parts: 96-072x2 Hold-Up Latch
911-066x2 Carriage Return Cam*

*This cam is included in revised main cam shaft described in No. 1 of this release....If it is installed separately, on a main cam shaft in a machine, the pin holes should be aligned, reamed and an oversize taper pin installed.

Installation of the revised parts in production machines began with serial no. B-980353

Installation in field machines in NOT recommended unless there is a severe and continuing history of difficulties of the nature described above...or if it is necessary to install the improved main cam shaft (No. 1 in this release).

No. 8 Improved "Soft Lock" Links

The "soft lock" links for both the selector and multiplier decimal capacity locks have been revised. The revision is simply a change from a round hole to a slot at the point where the links connect to the multiplicand and multiplier bails. This will eliminate a conflict between the "hard" and "soft" locks of the two mechanisms which could occur with certain unusual decimal settings.

This conflict would occur if the whole number capacity of one mechanism were exceeded (activating its "hard lock") and the decimal capacity of the other mechanism...but not its whole number capacity...were also exceeded. If one of the keys, whose decimal capacity had been exceeded, were then firmly depressed...the opposing active "hard lock" could restrict movement of the "soft lock" linkage enough to permit tripping of the main shaft clutch. The main shaft would then advance to hold-up position and stop... with the motor running.

The change to slotted holes eliminates this possibility by permitting the links to move forward on the studs of the multiplicand and multiplier bails. If one of the bails is prevented from moving by its "hard lock", movement of the "soft lock" linkage will not be restricted.

Revised Parts: 97-074a (2 used) Lock Link

Installation of revised parts in production machines began with serial no. B-980185.

Updating of field machines will not be required, except in cases where the problem described above has been experienced.

No. 9 Improved Switch Release Ratchet Pawl

The shape of the lower lug of the Ratchet Pawl has been revised to prevent raising of the back space pawl when the switch closing cam is being returned to neutral.

In some instances the back space pawl was raised slightly by the ratchet pawl causing an unsatisfactory tooth "hold" which resulted in excess wear on the ratchet teeth of the switch closing cam.

Revised Parts: 910-069x1c Ratchet Pawl

Installation of the improved pawl in production machines began with serial no. B-976087.

An improved pawl, (and a new switch closing cam) should be installed in field machines when wear of the ratchet teeth is encountered.

No. 10 Strengthened Decimal Pointer

Two changes have been made on the decimal pointer to eliminate breakage. The stock thickness of the material has been increased from .010 to .015 and stock has been added to increase strength near the tip of the pointer.

Revised Part: 97106c Decimal Pointer

Installation of improved pointers in production machines began with serial no. B-881250.

Strengthened pointers MUST be installed in all machines in Branch stock before delivery to a customer....Updating of customer machines, at the convenience of the Branch, is recommended as a reliability improvement.

No. 11 Strengthened Ribbon Reverse Slide

A reinforcing rib and lengthened guide slots have been added to the Ribbon Reversing Slide to strengthen the part and eliminate cramping when reversing mechanism is functioning.

Revised Parts: 98096a Ribbon Reverse Slide

Installation of the improved slide in production machines began with serial no. B-976147.

Installation of improved slides in field machines is NOT recommended except in machines which have a severe and continuing history of ribbon reverse troubles.

No. 12 Strengthened Decimal Shafts Detent Spring

The diameter of the wire used for the plunger springs which detent the decimal shafts has been increased from .010 to .012. This has been done to provide a more positive detenting action for the decimal control knobs.

Revised Part: 581a Detent Spring

Installation of the strengthened springs in production machines began with serial no. B-881208.

Updating of field machines is NOT recommended unless the decimal unit must be disassembled for some other reason.

No. 13 Improved Selectors

Certain changes in material and improvements in manufacturing inspection techniques have resulted in the production of selectors in which the control of zoning and overall quality and reliability has been improved.

The part no. (92-2000x1) of these improved selectors has not been changed....They are identified by a marking of blue dye across the teeth of the "fixed" gears.

Installation in production machines began with serial no. B-980761.

Improved selectors should be installed ONLY in those field machines which have a history of miscals related to critical selector adjustment. (See also No. 14 of this release).

No. 14 Improved Register Units

The end play of intermediate gears, in register units of current manufacture, is being held to a closer tolerance (.003 max.). This improved zoning control, along with similar selector improvement (No. 13 of this release) will provide improved reliability and a less critical selector adjustment.

There is no change in the part no. (92-2001) of the register unit ....Improved units are identified by a marking of blue dye on the hub at top of left end plate.

Installation in production machines began with serial no. B-980376.

Improved register units should be installed ONLY in those field machines which have a history of miscals related to critical selector adjustment...and in which this problem was not eliminated by installation of the improved selector.

No. 15 Improved Accumulators

Several improvements have been made in current accumulators....The end block at the right end is now drilled and pinned to the shafts to eliminate any possibility of the block moving on the shafts.... A more durable plastic material is now being used for both the right and left end blocks. The superior stress-resistant characteristics of this new material will greatly improve accumulator reliability. The accumulator detent bail is now being held to closer tolerances to assure parallel alignment with the gears.

The accumulator part no. (94-4001) has not been changed....Improved accumulators are identified by a marking of blue dye on the outer faces of the end blocks.

Installation of improved accumulators in production machines began with serial no. B-980157.

Improved accumulators MUST be installed in all machines in Branch stock before delivery to a customer....Updating of customer machines, at the convenience of the Branch, is recommended as a reliability improvement.

No. 16 Improved Program Cam Shafts

A more durable material is now being used for the plastic cams on the division, multiplication and 1/2 cent multiplication program cam shafts. Also, a very slight radius has been added to the inner corners of the cam keys. The additional strength provided by these changes will greatly improve the reliability of these parts.

All three improved program cam shafts are easily identified by their shaft length....They are about 1/8 inch longer than the previous style (NOTE: This change in length was made to facilitate installation of the cams on the shafts in production and it is not directly related to the reliability improvements described above. However, since the longer shaft is being incorporated at the same time as the other changes, we can use it as a means of identifying the improved parts.)

Revised Parts:	99-004xle	Div. Program Cam Shaft
	99-014d	Mult. Program Cam Shaft
	99-020a	1/2 Cent Mult. Program Cam Shaft

Installation of revised program cam shafts in production machines began with serial no. B-980397.

These improved shafts must be installed in all prior machines in Branch stock before delivery to a customer....Updating of customer machines with the new shafts is also recommended....In any case; whenever one of the previous style shafts is replaced, the other previous style shaft/s should be replaced at the same time.

No. 17 Improved M/Q Decimal Programming

The angle of the camming extension on the cam bail of the decimal actuator arm shaft has been changed from 30° to 40°. The point at which this angle forming starts has been moved further from the shaft center...and the decimal intermediate arm has been revised to operate properly with the changed cam bail. These changes have been made to insure full positioning of the actuator arm shaft in decimal programming for multipliers and quotients.

Revised Parts:	97-008c	Dec. Actuator Arm Shaft
	97-101xla	Dec. Intermediate Arm*

*Note: The hub of this part has also been shortened for use with the new main cam shaft brace (See No. 1 of this release).

Installation of this improvement in production machines began with serial no. B-980353.

Updating of field machines is NOT recommended (unless a new main cam shaft, with brace, is being installed).

No. 18 Improved Program Feed Lever

The shape of the end of the program feed lever...the end which engages in the program feed plate...has been revised. This end now has a "shoulder" on both sides of the operating tip which will prevent the feed plate from moving closer to the pivot point of the lever. This will eliminate a cause of lost motion in the program feed mechanism.

Revised Part: 99175x1a Program Feed Lever

Installation of the improved lever in production machines began with serial no. B-980403.

The improved lever should be installed in any field machines in which difficulty with obtaining full program feed has been experienced.

No. 19 Eliminating Set-Up Carriage Reset Link "Cramp"

The location of the hole, for the eccentric stud, in the rear pulley arm has been moved slightly forward to eliminate a possible cramping condition which could occur when this pulley arm was driven fully rearward by the carriage return cam. This will also provide more latitude for adjusting the eccentric stud...which carries the set-up carriage reset link.

Revised Part: 913-069x1c Rear Pulley Arm

Installation of this part in production machines began with serial no. B-980252.

It is not necessary to update field machines with this part....Field machines, in which the cramping condition is encountered, can be corrected by installing a smaller roller (part no. 911814) on the carriage return cam follower.

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Printed in U.S.A. Supplement of 10/27/67

Please insert this Supplement in proper sequence in your copy of C.S.B.#P2-502.

The following procedure outlines the steps necessary for installation of the strengthened Hold-Up Bell Crank bracket (96119).

Remove the following parts from machine for access to area requiring drilling:

6	Screw
70	Washer
97-071a	Arm
96073xla	Arm
96386	Pulley
97070	Bail
96103	Link

Remove rivets securing old style bracket with center punch and hammer.

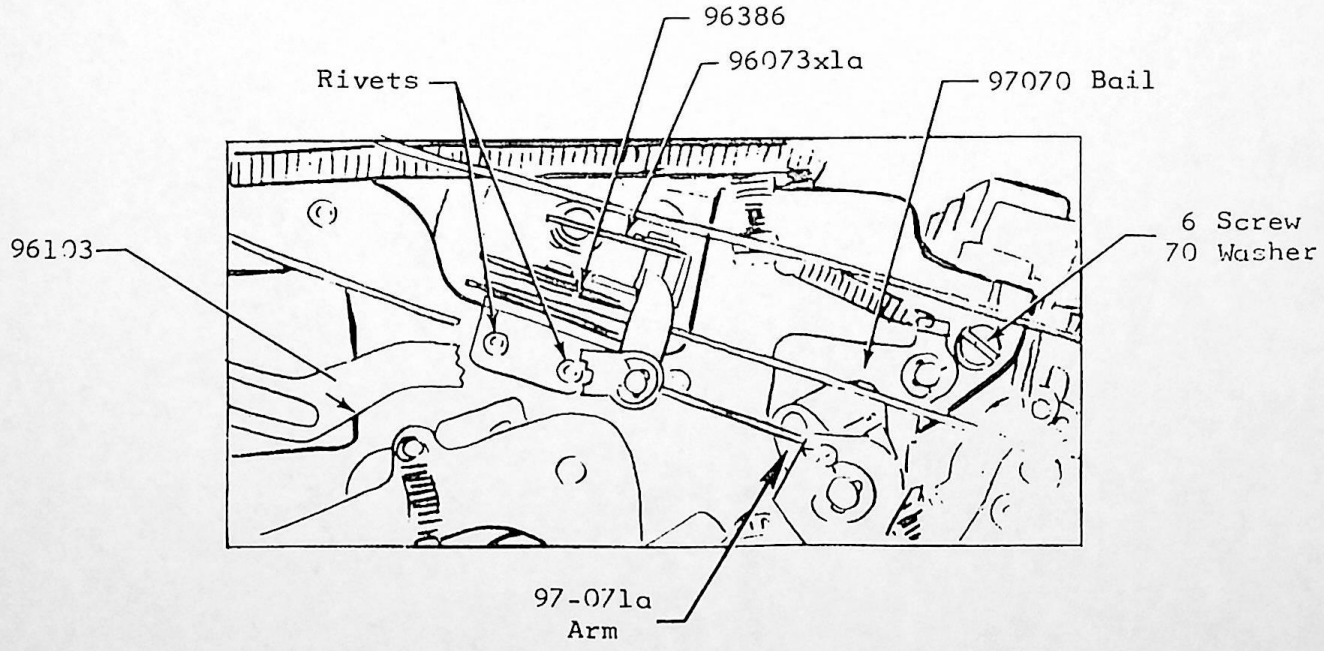
Cut out template on outline. Cut out holes A, B & C.

Secure location "A" on the paper template to the side frame of the machine with the #6 screw.

Slot "B" of the template locates over the stud from which the 97070 bail was removed.

Insert a 3/32" punch with tapered shank through hole "C" of the template and through the rear-most rivet hole to locate template.

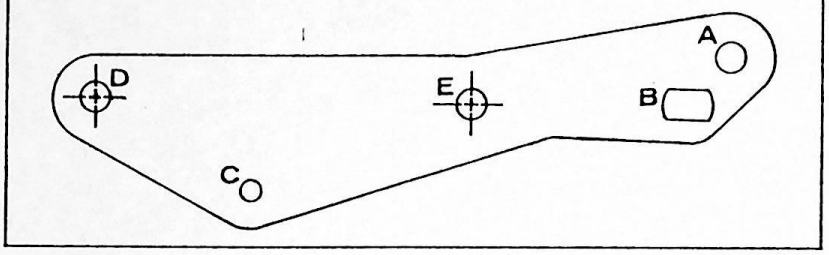
Center punch holes "D" and "E" and drill with a #28 drill (size .140).

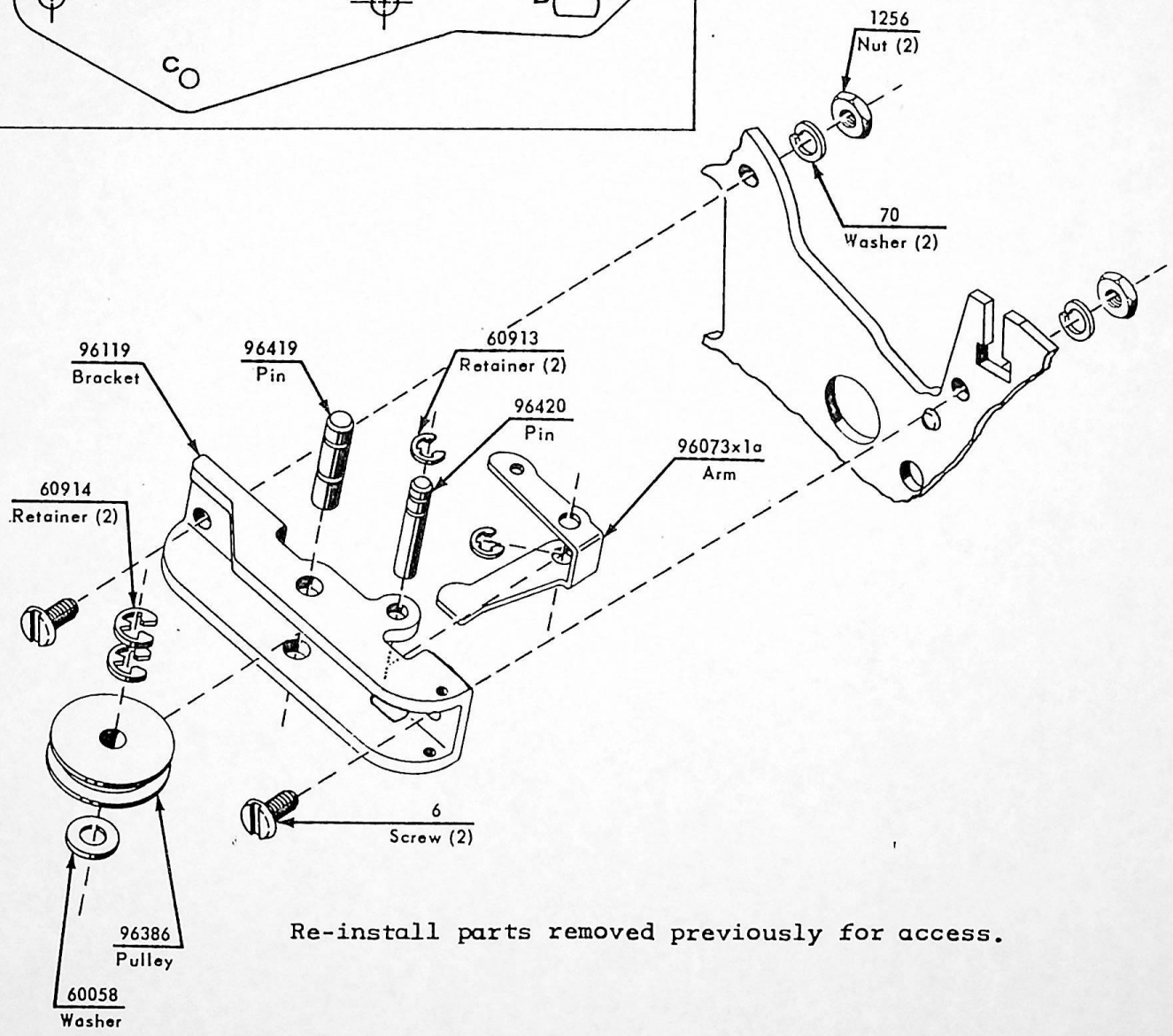


Install parts:

96119	Bracket
1256	Nut (2)
70	Washer (2)
96419	Pin
96386	Pulley
60058	Washer
60914	Retainer (2)
96420	Pin
96073xla	Arm
60913	Retainer (2)

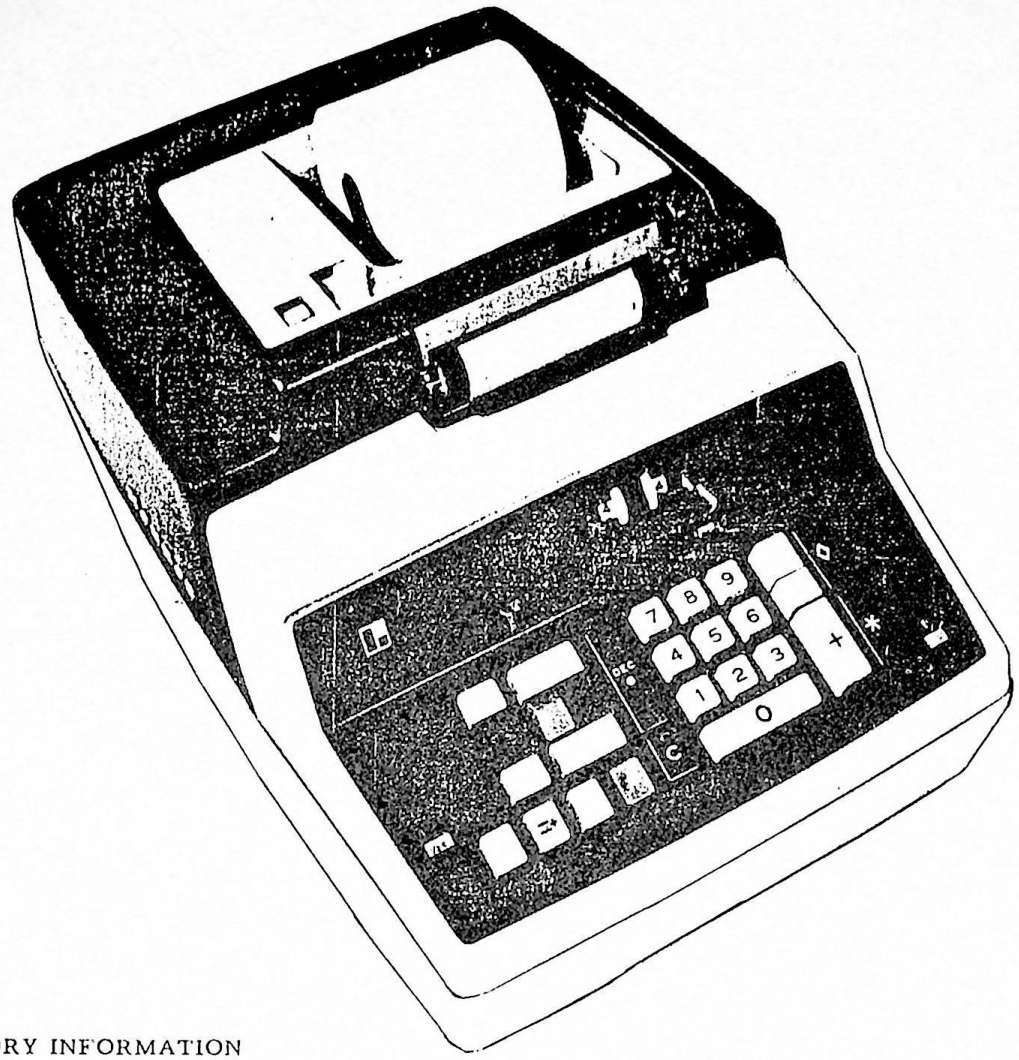
DRILL TEMPLATE





Re-install parts removed previously for access.

Supplement of 6-13-66



INTRODUCTORY INFORMATION

The 211PC193 model contains a "½ cent" multiplication round off mechanism....Otherwise it is identical to the 211PC192 model.

The ½ cent mechanism is applicable to the rounding off of multiplication products only. It does not function on other operations. A ½ cent control slide can be positioned to select either the ½ cent or regular multiplication operation. The ½ cent mechanism operates around a fixed product decimal position between the 8th and 9th column (eight decimal places). The ½ cent round off is accomplished by adding a "5" to the product in the sixth (mills) column. Therefore, if the actual figure in this column is "5" or more, the additional "5" will cause a carry-over (round off) into the seventh (cents) column. If the actual figure is less than "5", the additional "5" will not result in a carry-over. Zeros print in the first six columns of the product. (Any actual figures in these register gears are removed on a subsequent non-print cycle).

A ½ cent multiplication requires four cycles of the main shaft instead of the two cycles required by a normal multiplication. A ½ cent mult. program cam shaft controls the operation.

On the first cycle...which is a non-print cycle... a "five" is added to the sixth column register gear. On this cycle a three position ½ cent zero stopping bail moves down into engagement with hooks on top of the forward ends of the front racks....The sixth column rack hook is extended forward so that the rack is permitted to move to "5" before stopping. All other racks are stopped at zero.

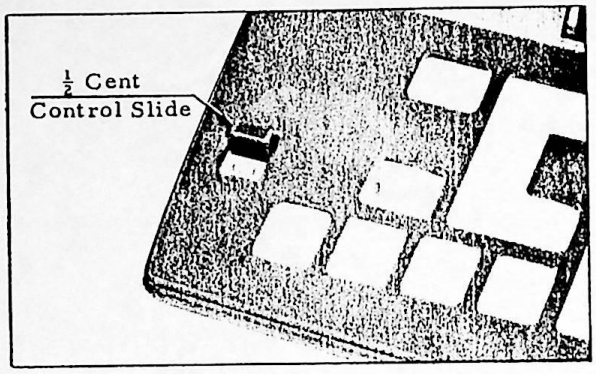
The second and third cycles are regular mult. cycles...except on the third (product) cycle the three position ½ cent zero stop bail moves up into engagement with hooks on the lower edge of the front racks and stops the first six numeral racks at "zero".

This necessitates a fourth cycle to clear out the amount in the first six columns of the register....The fourth cycle is also a non-print.

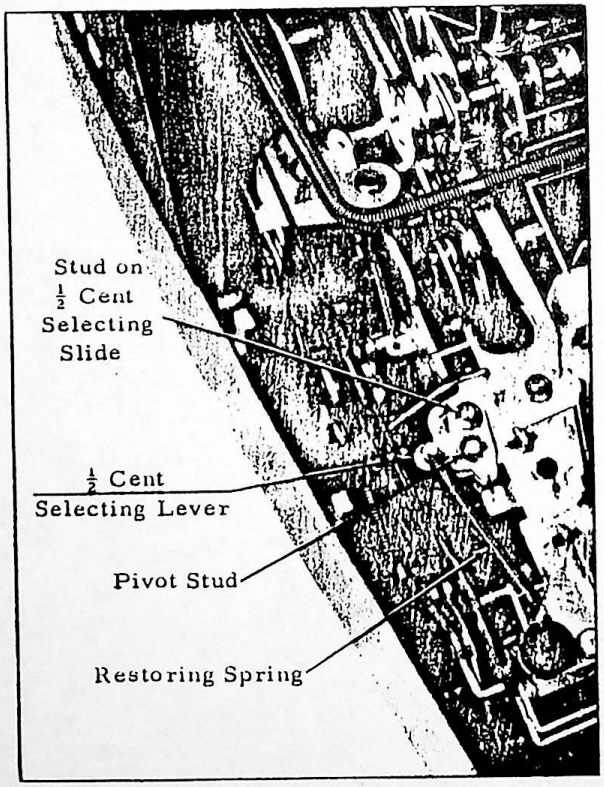
Note: The three position ½ cent zero stop bail normally rests in its middle position where it does not affect the movement of the racks.

ON/OFF CONTROL

A two color ½ cent control slide is located on the left side of the keyboard. When forward, it is the same charcoal gray color as the keyboard top plate and it has no identifying marks. When rearward, it displays a "½" cent symbol on a turquoise background.

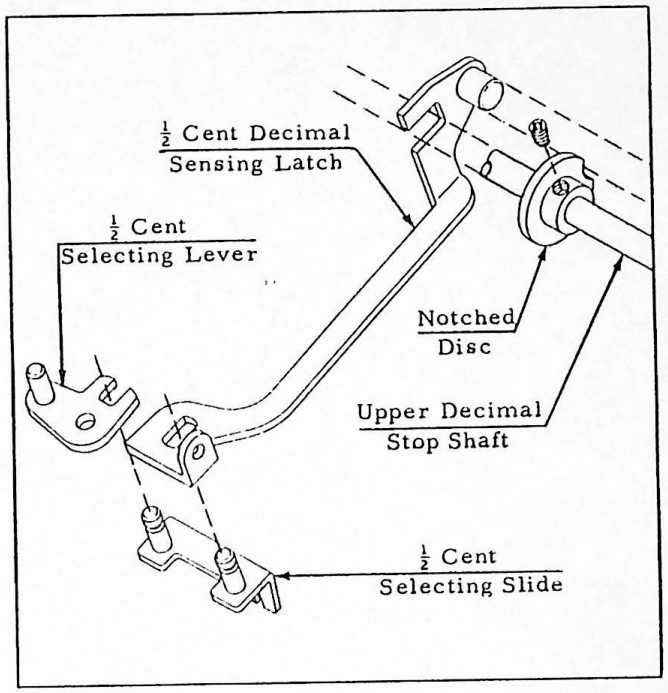


An aperture in the lower side of the on/off control slide fits over an upward projecting stud on the ½ cent selecting lever. This lever pivots on a stud in the left control keyboard plate. A slot in this lever operates over a stud which projects up thru a slot in the keyboard plate. This stud is on the left end of the ½ cent selecting slide. Therefore, when the control slide is pushed rearward, it pivots the lever in a clockwise direction against the tension of its restoring spring and the lever pushes the selecting slide to the right.

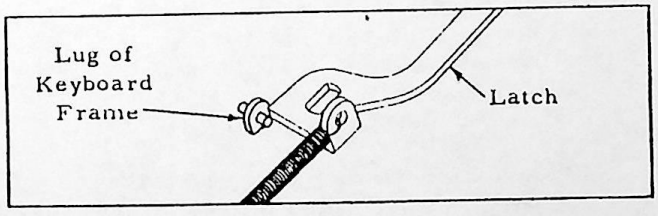


½ CENT DECIMAL SENSING LATCH

Another stud on the selecting slide extends upward thru another slot in the keyboard plate. This stud engages in a forward to rearward extending slot in the ½ cent decimal sensing latch. Therefore, when the selecting slide is moved to the right, it moves the forward end of the sensing latch to the right. A spring, attached to the forward offset lug of the sensing latch, exerts forward tension on the latch.



The rearward end of the sensing latch has an upward projecting extension which is slotted to fit over the upper decimal stop shaft. A large diameter stud, riveted to the sensing latch extension, rides on the outer diameter of a notched disc. This disc is set-screwed to the upper decimal stop shaft in such a position that, whenever a total of eight decimal places has been selected in the decimal control knobs, the notch in the disc presents itself to the stud on the sensing latch. This permits the latch to be pulled partially forward by its spring until its straight front edge limits against the lug of the keyboard frame. Then...when the selecting slide is moved to the right...the front edge of the sensing latch is moved to the right of the lug where its spring pulls it further forward so that its left edge latches behind the right edge of the lug.

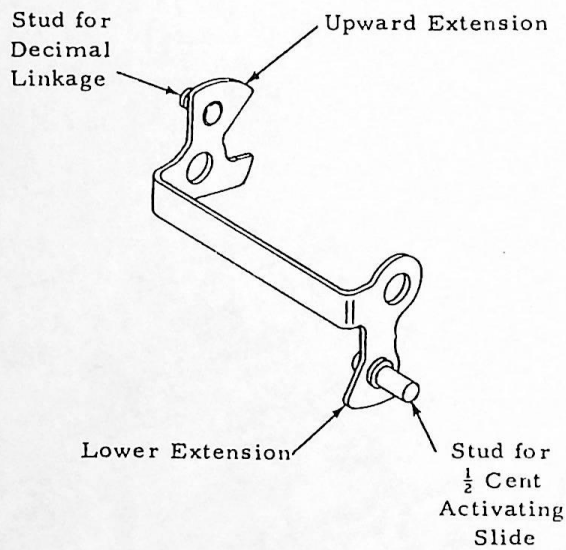


This mechanism is thus latched in ½ cent position and the control slide cannot itself be manually moved forward to its normal position. To restore the mechanism to normal it is simply a matter of changing the decimal control setting to something other than a total of eight.... When one of the knobs is moved, it turns the notched disc, which cams the sensing latch rearward... unlatching it from the lug of the keyboard frame. The restoring spring on the selecting lever then rocks the lever in a counter-clockwise direction... restoring the control slide, selecting lever, selecting slide and sensing latch.

PROGRAM SELECTION

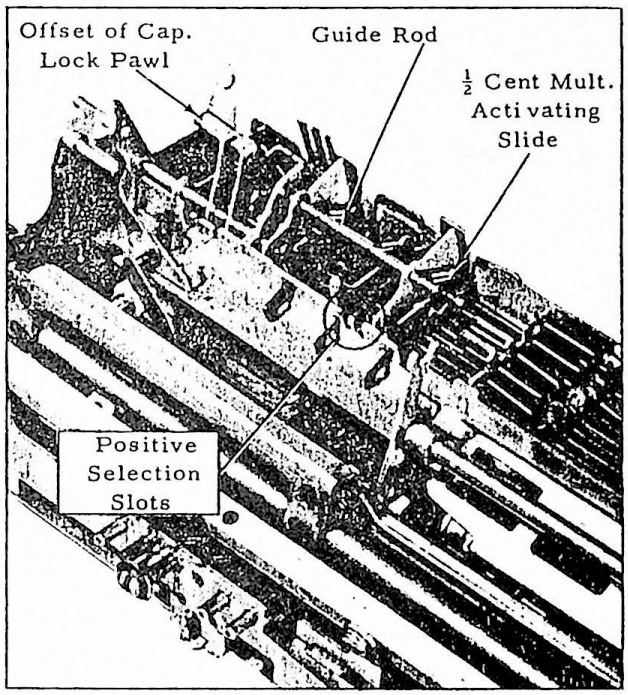
The function of the multiplier bail in relation to the capacity lock mechanism is the same as previously described for the 211PC192 model (pages V-D-2 thru V-D-10). However, several alterations in the parts have been made to accommodate the ½ cent mechanism.

MULTIPLIER BAIL FOR ½ CENT



The upward extension of the multiplier bail has been extended further upward to engage with a slot in the ½ cent selecting slide. This bail extension has also been extended further rearward (fan shaped) so that it will remain in engagement with the slide when it is pivoted by a mult. key. The multiplier bail is no longer secured in its lateral position by a retainer and spacing sleeve ....It is now free to move laterally (as positioned by the selecting slide). Also, the stud connecting it to the decimal linkage is longer....This provides a "sloppy" lateral fit, to accommodate the lateral movement of the bail. The bail has also been made somewhat longer from left to right to provide more lateral movement. The stud in the lower extension of the bail, which formerly extended only to the left... to operate the regular mult. activating slide... now also extends to the right... to operate the ½ cent mult. activating slide. This lower extension of the bail has also been extended further downward and has been "fan shaped" to operate in the "positive selection" slots that have been added to the symbol program unit frame. These slots prevent the pivoting of the bail (and thus the depression of the mult. keys) unless the bail is fully located in either its normal or ½ cent lateral position.

The upper offset of the multiplier capacity lock pawl has also been extended so that it will function with the multiplier bail in either of its lateral positions.

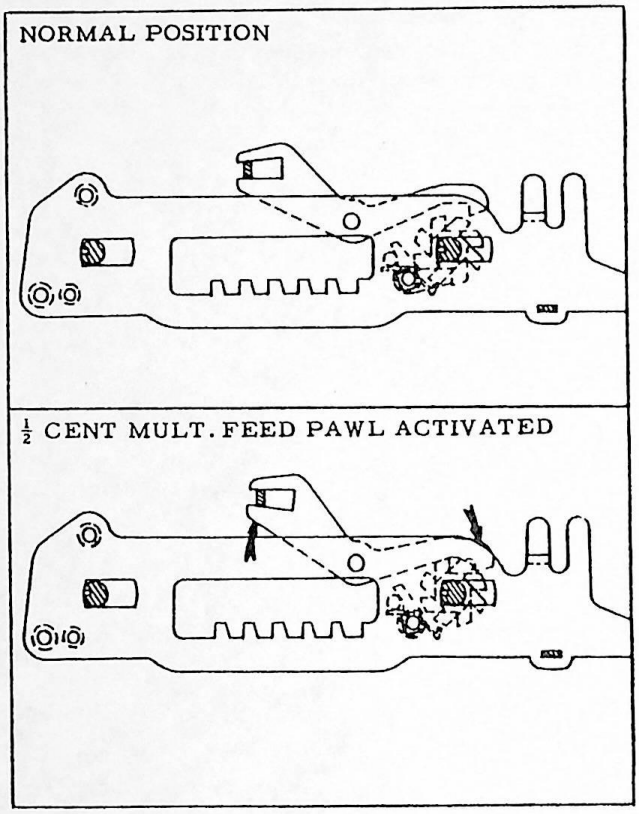


A ½ cent mult. activating slide has been added... to the right of the regular mult. activating slide. The guide rods for the activating slides have been extended, the right support bracket for the guide rods has been moved a little to the right and slots have been added to the front and rear frames of the symbol program unit to accommodate the new ½ cent mult. activating slide.

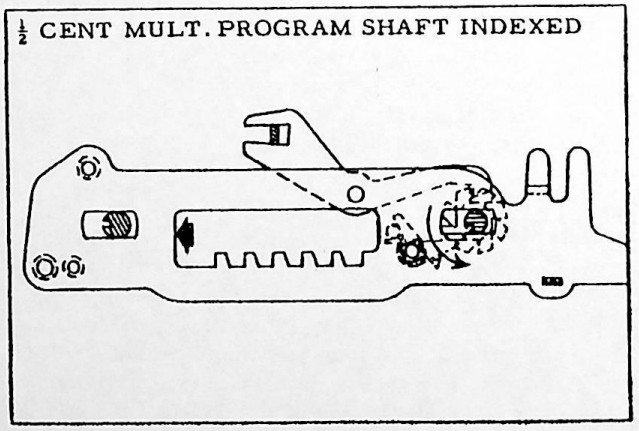
Therefore, when the ½ cent control slide is pushed rearward, moving the ½ cent selecting slide to the right... the selecting slide moves the multiplier bail to the right. This moves the left end of the stud on the lower extension of the multiplier bail out of alignment with the regular mult. activating slide and the right end of the stud into alignment with the ½ cent mult. activating slide.

FIRST ½ CENT MULTIPLICATION CYCLE

With the control slide in ½ cent position, depression of the multiplication (=) key rocks the multiplier bail which pushes the ½ cent mult. activating slide rearward. A spring raises the rear end of the slide as it moves rearward. The rear extension of the slide, engaged in a slot of the upper ½ cent mult. feed pawl, rocks the left end of the pawl upward. This pivots the operating tip on the right end of the pawl down into alignment with the inner feed ratchet gear on the rear end of the ½ cent multiplication program cam shaft.

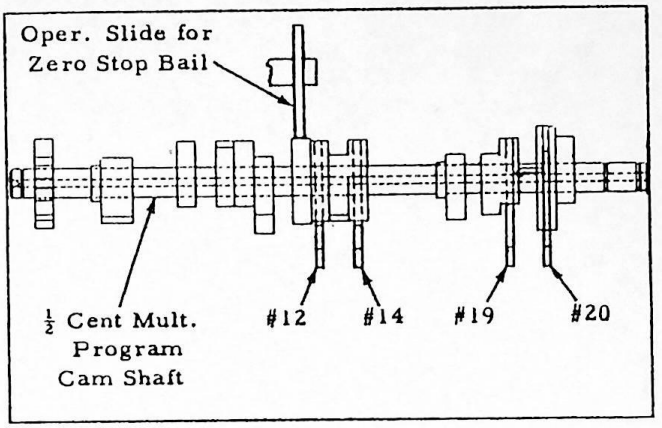


As the main cam shaft cycles, the program feed plate is driven to the left. The upper ½ cent mult. feed pawl indexes the ½ cent mult. program cam shaft to its first active detent position.



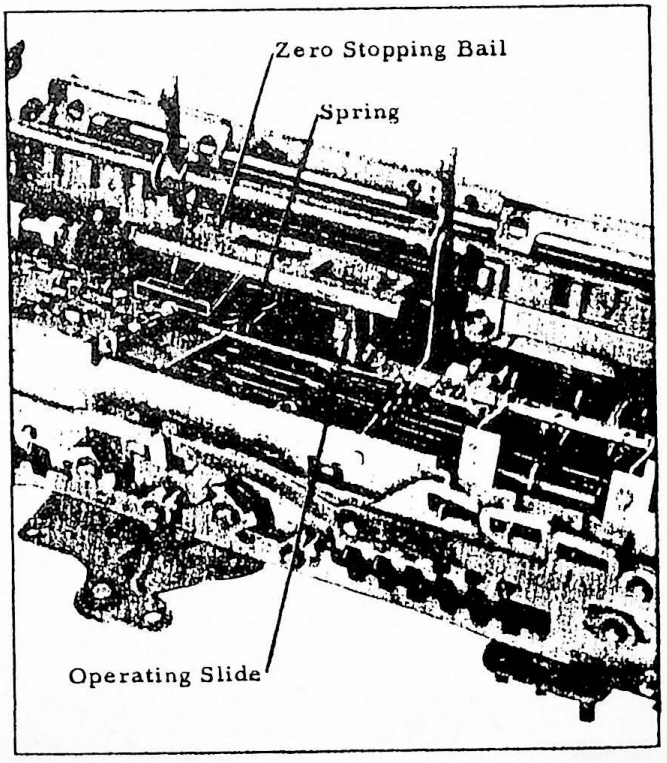
As the shaft is indexed, its program cams activate the following program slides:

Operating Slide for zero stopping bail (no #)
Non-Print (#12)
Hold-Up Latch Disabling (#14)
Enter Register (#19)
Repeat (#20)



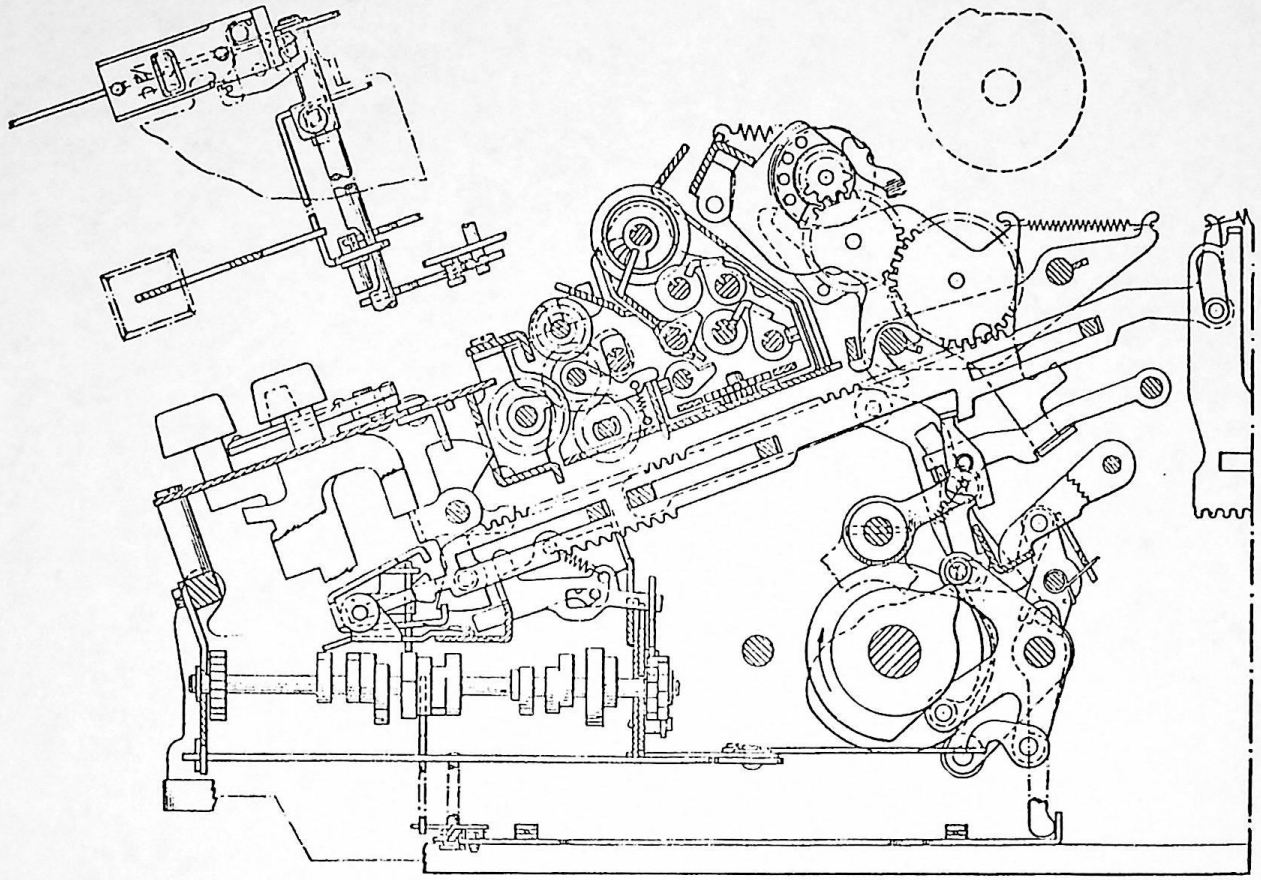
OPERATING SLIDE FOR ZERO STOPPING BAIL

This slide is positioned vertically in a bracket mounted on the front frame of the symbol program unit. The slide rides one of the cams on the ½ cent program cam shaft.

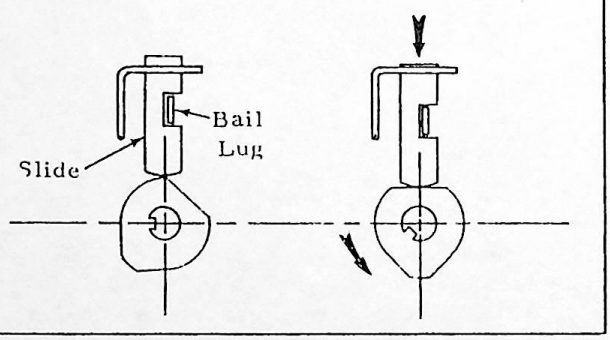


A notch in the upper part of the slide fits over a lug on the zero stopping bail. A spring, connected between the stopping bail and the mounting bracket, holds the bail down and the bail holds the operating slide down against its cam.

REFERENCE VIEW

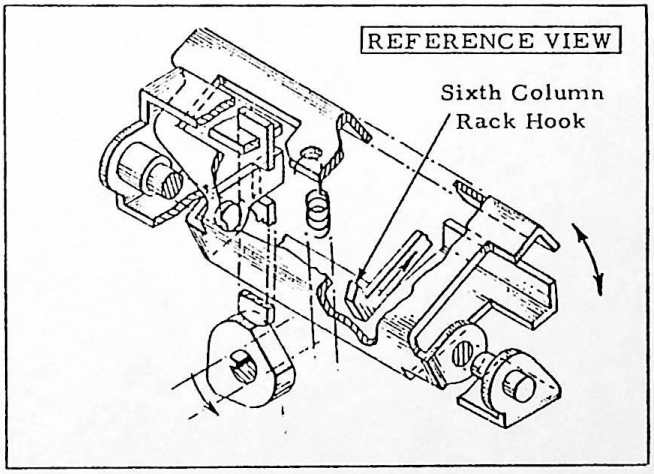


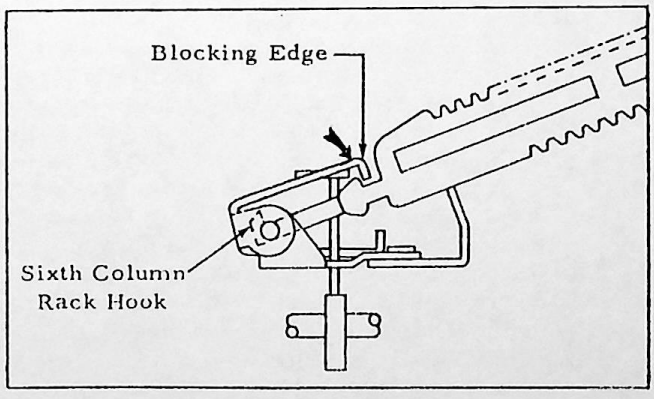
OPERATING SLIDE FOR ZERO STOP BAIL



As the program shaft moves into its first detent position, a low section of the cam moves under the operating slide and the spring pulls the stopping bail and slide downward. This moves the blocking edge on the upper part of the bail into engagement with the hooks on top of the forward ends of the front racks. In this position the bail will stop all of the racks...except the sixth column rack...in zero position when the rack restoring bar moves rearward. The hook on top of the sixth column rack is extended forward so that this rack will be permitted to move rearward five teeth before its hook is stopped by the bail.

REFERENCE VIEW





NON-PRINT PROGRAM SLIDE (#12)
(See page IV-C-22)

HOLD-UP LATCH DISABLING PROGRAM SLIDE (#14)
(See page IV-C-12)

ENTER REGISTER PROGRAM SLIDE (#19)
(See pages V-A-2, 3 and 4)

Note: This program slide along with the control slide control bail and latch which it operates are all previously identified in this manual as "Enter Dividend" controls... since the enter dividend function was the only one which they performed at the time the other material was written. Now, however, since these parts are also utilized in the $\frac{1}{2}$ cent multiplication function to enter the "5" in the sixth column register gear, the term "Enter Register" provides a more accurate description of their function.

REPEAT PROGRAM SLIDE (#20)
(See page V-D-15)

Summary of the program feed stroke:

a. The operating slide for the zero stopping bail lowers the bail to block all racks except #6 at zero.

b. Program slide #12 disengages the hook from the hammer latch raising bail and operates the lever for no platen space.

c. Program slide #14 pivots the hold-up latch so the main cam shaft will not be stopped in hold-up position.

d. Program slide #19 raises the latch on the #1 operating slide to engage the register with the racks at the end of the first half cycle.

e. Program slide #20 engages clutch reset arm latch to disable clutch restoring mechanism.

As the main cam shaft cycles thru the hold-up (30°) position the rack restoring cam follower springs pivot the rack restoring cam followers in a clockwise direction (as viewed from the right side) as the follower rollers move into the low section of the rack restoring cams. This pulls the rack restoring bar to the rear.... All racks except the rack in the 6th column are held at zero by the zero stopping bail. The 6th rack is allowed to move rearward five teeth... which enters a "5" in the print wheel. However, the hammer latch raising bail has been disengaged by the #12 program slide and no print will occur.

Immediately after the rack aligners engage the racks, the #1 operating slide is driven forward and the latch that was positioned to the rear of the register engaging segment, pivots the segment, driving the register into mesh with the racks.... As the racks are restored to their neutral position, "5" is entered into the 6th column register gear. At the end of the forward movement of the racks the #1 operating slide is driven rearward by its cam and the register engaging segment is returned to neutral by its spring. This raises the register to its neutral position where it is locked.

When the main shaft has almost completed the 360° rotation, the feed plate is driven to the right and the lower feed pawl pivots the $\frac{1}{2}$ cent mult. program cam shaft to the second detent position.

Movement of the cam shaft to its second detent position restores the following program slides to their neutral positions:

Operating Slide for zero stopping bail
Non-Print (#12)
Hold-Up Latch Disabling (#14)
Enter Register (#19)

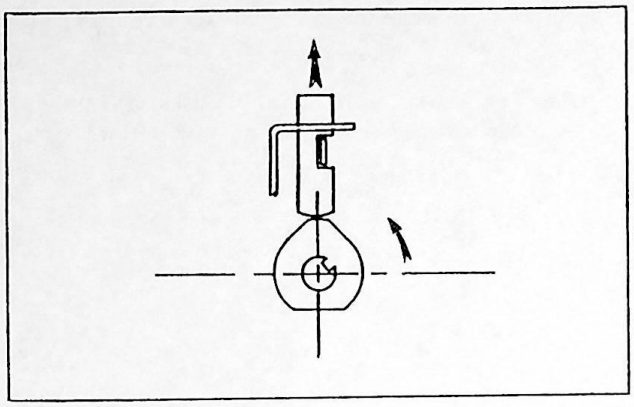
The repeat program slide (#20) remains activated to the left... so the main shaft goes thru its home position and starts into the second cycle.

The second and third cycles of $\frac{1}{2}$ cent multiplication are exactly the same as the two standard cycles of regular multiplication (described on pages V-D-12 thru V-D-33)... with the following exceptions:

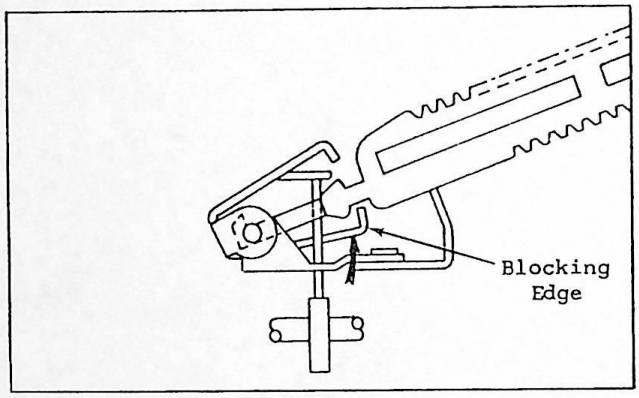
a. At the beginning of the second $\frac{1}{2}$ cent multiplication cycle, the repeat program slide (#20), having already been activated on the first cycle, remains in its active position. Thus it is not necessary to activate it at this time as it would be at the beginning of the comparable first regular multiplication cycle.

b. At the beginning of the third $\frac{1}{2}$ cent multiplication cycle, the repeat program slide (#20) is not restored to neutral as it would be at the beginning of the comparable second regular multiplication cycle.... This slide is retained in its active position at this time to provide for the fourth $\frac{1}{2}$ cent mult. cycle.

c. Also, at the beginning of the third $\frac{1}{2}$ cent multiplication cycle, the operating slide for the zero stopping bail is driven upward by its cam.



This positions the blocking edge on the lower part of the bail into engagement with hooks on the lower edges of the forward ends of the front racks.



The lateral width of this blocking edge is such that it only engages the first six numeral racks. Therefore, when the register is totaled on this third cycle, the zero stopping bail will prevent the totaling of its first six (low order) columns and zeros will be printed in these columns if any amount is present in the seventh or any higher order columns.

d. The zero stopping bail is restored to its neutral position at the end of the third $\frac{1}{2}$ cent multiplication cycle.

e. Also, at the end of the third $\frac{1}{2}$ cent multiplication cycle, the register total program slide (#9) is not restored to neutral as it would be at the end of the comparable second regular multiplication cycle.... This slide is retained in its active position at this time to provide for removal of the amount in the first six register gears on the fourth $\frac{1}{2}$ cent mult. cycle.

FOURTH $\frac{1}{2}$ CENT MULTIPLICATION CYCLE

As the $\frac{1}{2}$ cent program cam shaft is indexed to its seventh detent position, its cams activate the Non-Print Program Slide (#12) and the Hold-Up Latch Disabling Program Slide (#14) and release the Repeat Program Slide (#20)

Program slide #12 disengages the hook from the hammer latch raising bail and operates the lever to prevent platen space (see page IV-C-22).

Program slide #14 pivots the hold-up latch so the main cam shaft will not be stopped in hold-up position (see page IV-C-12).

Therefore on this final cycle, any amount that may have remained in the first six columns of the register will be removed, but not printed.

As the main cam shaft cycles, the #2 operating slide is driven forward and engages the register with the rear racks. Racks 1 thru 6 (if a figure is in the register gears) move rearward until the register gears limit on their total hooks. Because #12 program slide was activated, no print will occur. After the racks align, the #2 operating slide moves rearward and the register, thru its neutralizing spring, is raised out of mesh with the rear racks and the racks then move forward to their neutral position.

As the program feed plate is driven to its neutral position near the end of this cycle, it indexes the $\frac{1}{2}$ cent mult. program cam shaft to its neutral position. This releases the Non-Print Program Slide (#12) and the Register Total Program Slide (#9) which are then restored to their neutral positions by their bellcrank springs. The Hold-up Latch Disabling Program Slide (#14) is also released and it is restored to its neutral position by the spring on the hold-up latch. The mult. keystem is also released and restored to neutral and the $\frac{1}{2}$ cent multiplication operation is complete.

OPTIONAL DECIMAL SETTING

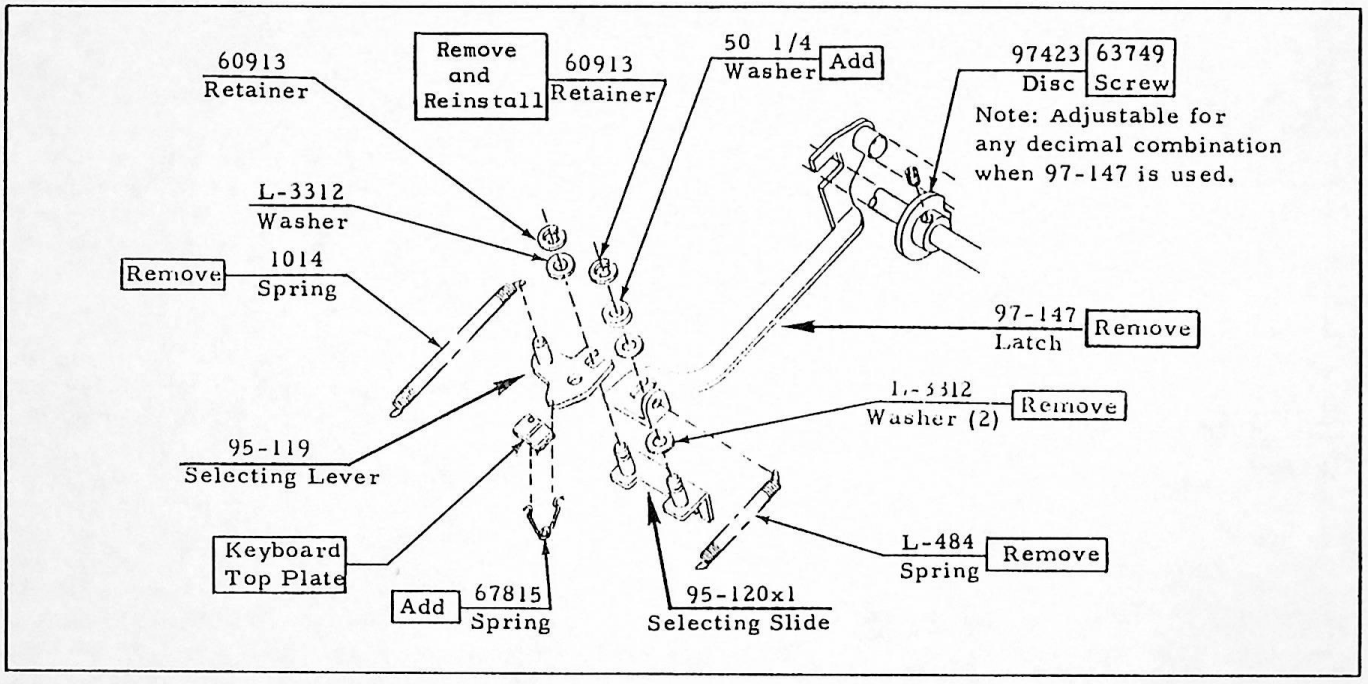
As described previously, the standard 211PC193 model is set so that the $\frac{1}{2}$ cent mechanism can only be used when a total of eight decimals have been selected. To meet customer requests, however, the decimal setting which permits use of the $\frac{1}{2}$ cent mechanism can be changed by Branch Service Departments to any total from "0" thru "14". This is accomplished by adjusting the rotary position of the notched disc on the upper decimal stop shaft to conform to the desired setting.

OPTIONAL DECIMAL LOCK REMOVAL

Again, to provide for specific customer requests, the decimal locking feature of the $\frac{1}{2}$ cent mechanism can be removed altogether. This is accomplished as illustrated below.

NOTE: In instances where the decimal lock is removed altogether, there is the possibility an operator might have the $\frac{1}{2}$ cent control slide "ON" when not desired, and not be immediately aware of this. If this were to occur, the products would be rounded off when not intended and . . . if such products did not extend beyond the first six columns . . . no figure at all would print.

A thorough explanation of this is therefore essential to both the sales personnel and the customer.



NOTES

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Supplement of 8-16-66

Please insert this supplement page in proper sequence in your copy of C.S.B. #P2-502

NOTICE

THE "REPEAT" KEY SHOULD NOT BE USED TOGETHER WITH ANY OF THE THREE MULTIPLICATION KEYS (=, =+, =-) WHEN THE $\frac{1}{2}$ CENT MECHANISM IS ACTIVE.

Service and Sales Personnel are cautioned not to publicize any such application... and to consider it a misoperation.

As you know, use of the "repeat" key will cause the total/sub-total cam to be shifted to its sub-total position (page IV-G-3). Since this cam drives the #2 operating slide...and this slide moves the register into engagement with the racks on the product total cycle and also on the fourth (register clear) cycle of $\frac{1}{2}$ cent multiplication...the cam will cause the register to be sub-totalled if the repeat key is used. This will result in the product being retained in the register...and the product will contain any amount that may have been in the first six columns, including the "5" that was added to the sixth column register gear on the first cycle.

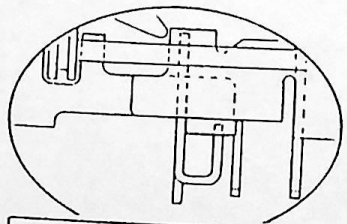
Therefore, the printed product would not correspond to the actual amount in the register...since the amount in the first six columns would not have been printed. If the amount in the register was then utilized in a subsequent calculation...as a dividend, for example...the result, while correct as far as the functioning of the machine is concerned, would appear to be a miscalculation when compared to the factors which the machine actually printed.

MODEL: 211PC192
SUBJECT: Failure to Program Fully in Transfer-Multiplication Operation
DATE: 5-19-67

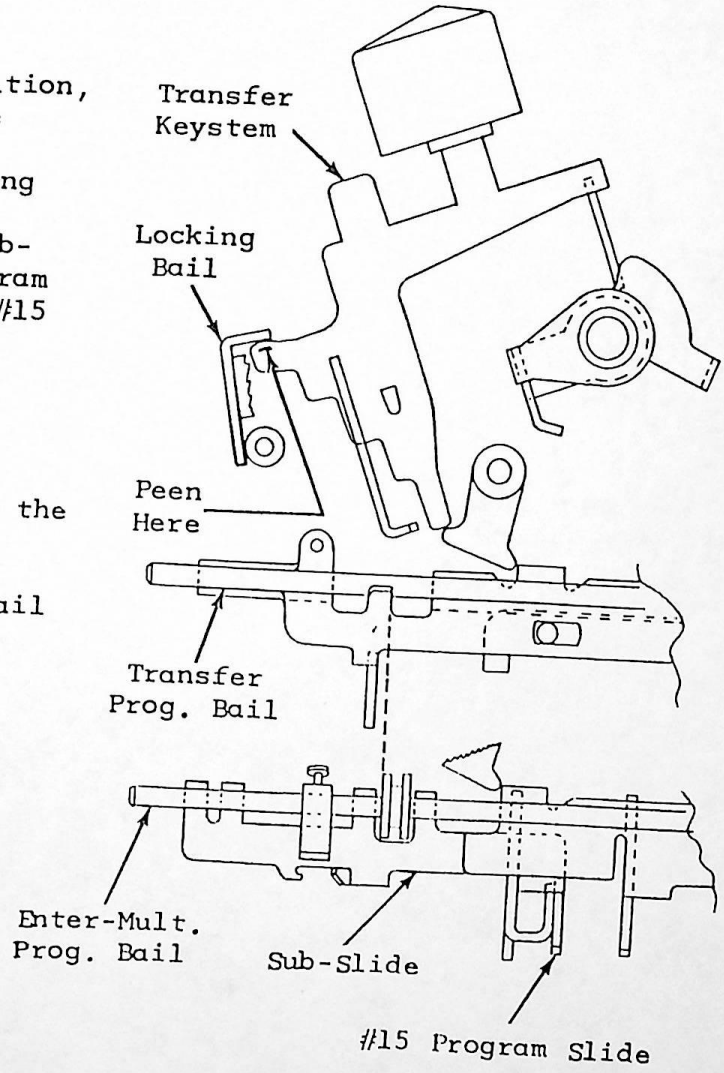
Condition - Machine jammed, motor running idle, selector in 1st position. Transfer program bail not fully restored.

Cause - On a quick stroke operation, the transfer keystem can have excessive afterlatch with the keyboard locking bail, allowing the transfer program bail to restore enough so that the sub-slide on the enter-mult. program bail can fail to program the #15 program slide.

Correction - Peen locking lug on the transfer keystem to reduce the amount of afterlatch clearance between the keyboard locking bail and the transfer keystem.



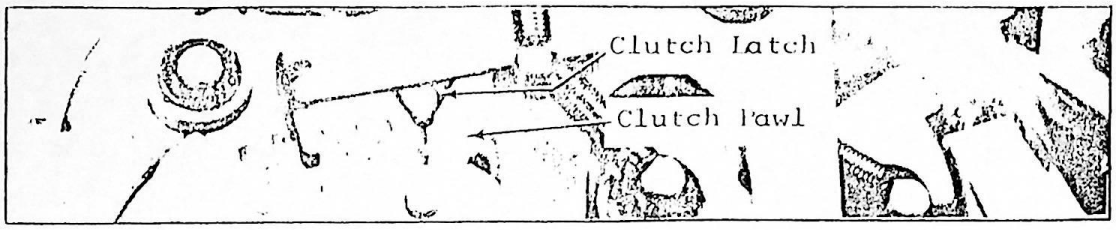
Insufficient Hold On #15 Prog. Slide

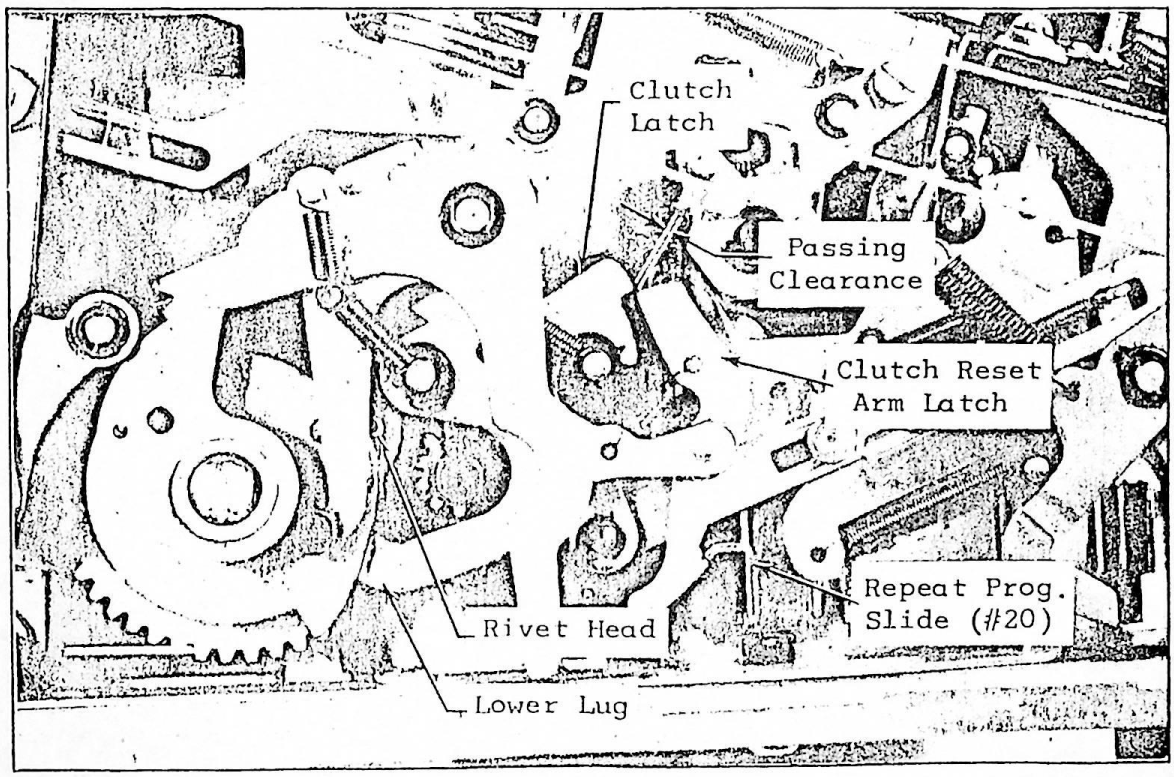


Note - Machines with Blue "LL" stamped on left keyboard top plate have been corrected for this condition. Design change is in process and will be released when available.

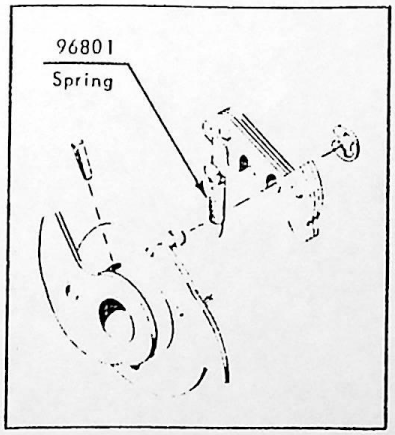
The following conditions can cause such a momentary interruption in the main shaft cycle:

a. Clutch reset arm latch "nipping" restoring step of clutch latch....This can rock the clutch latch down to where it "nips" the clutch pawl....To correct, form the left end of repeat program slide (#20) rearward enough to provide passing clearance of clutch reset arm latch at step of clutch latch.





b. Lower lug of clutch reset arm "nipping" head of rivet in clutch pawl.... To correct, form arm outward. Note: A change in design which is currently being processed will eliminate the "button-head" of this rivet.



c. Over-stressed set-up carriage return cable adjustment....To correct, re-adjust.

d. Weak main shaft clutch pawl spring....To correct, replace spring.

General Service Memo

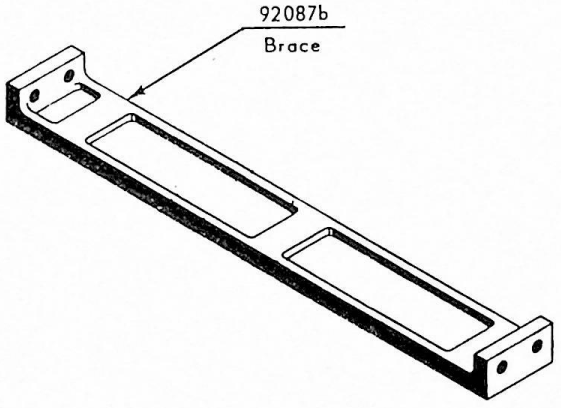
THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL,INC.

5-380
Boulder, Colo.

MODEL: 211PC192 & 211PC193
SUBJECT: Carry Unit Brace (92087b) Removed
DATE: 7-26-67

The carry unit brace, part no. 92087b, will no longer be used in finished machines. This part was designed as a production fixture to prevent distortion of the carry unit assemblies before they are installed in machines. Once installed, the units are rigidly secured and the brace is not necessary.

Do not order these braces for installation in machines which do not have them.



Note: Carry units ordered from stock will continue to be supplied with the brace in accordance with its intended purpose. When such units are installed in field machines the brace may either be left on the unit or removed.

[illegible] School
[illegible]
Los Angeles, Calif.

MODEL: 211PC192, 211PC193 and 611PR001
SUBJECT: Lubrication--Main Shaft Cam Follower
DATE: September 20, 1967

Condition - Lack of lubricant or deterioration of lubricant

Cause - Under normal conditions, lubrication (grease) will become partially dry. This condition, if not corrected, can cause extensive wear to the cam follower arm studs and rollers.

Keystone grease (Acc RR) should be used at all cam follower surfaces, both on the cam follower roller surfaces and the cam follower arm studs.

When keystone grease (Acc RR) is in evidence, around the cam followers, a few drops of "Uniflo" oil to the roller pivots will rejuvenate partially dried grease.

General Service Memo

THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL,INC.

5-330
Boulder, Colo.

SUBJECT: Case Cleaning

DATE: October 5, 1967

The use of Monroe Polish Accessory "C", and household powder cleanser, is an efficient and inexpensive method of cleaning smooth, unpainted plastic cases.

Application -

Place small amounts of Monroe Polish and Cleanser on a cleaning cloth. Rub this mixture onto the case surface, repeating this procedure until the entire case has been cleaned.

To clean residue from the case, use a mixture of "NL" concentrate "Accessory KKK", and water. Clean in and around "Monroe" plastic letters and textured front name plate with a brush.

A coat of "Monroe" Polish "Accessory C", may then be applied if a glossy finish is desired.

The above procedure will remove most types of inks and remove or reduce scratches from the case and keytops.

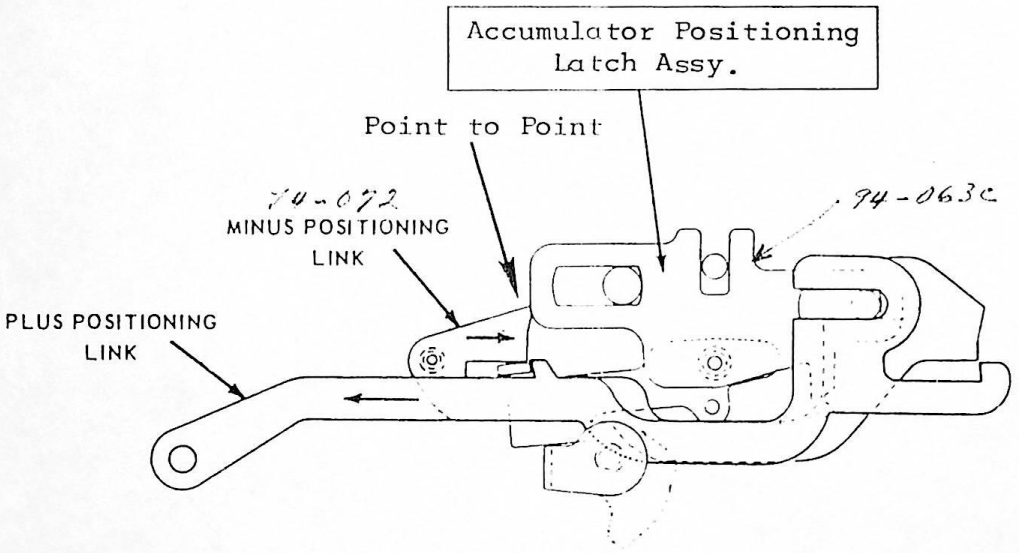
General Service Memo

THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL, INC.

MODEL: 211PC192, 211PC193
SUBJECT: Jam, Causing the 94-068 accumulator engaging arm to lose adjustment
DATE: October 6, 1967

Condition - Machine in a jammed condition on a plus operation. Removal of the motor cord releases the jammed mechanism, which caused the 94-068 accumulator engaging arm to lose adjustment.

Cause - Due to excessive lateral movement of the 94-072 minus positioning link, a point to point condition occurs between the 94-063 positioning latch assembly and the 94-072 minus positioning link.



Correction - Install shim washers #60061 as required, behind the 94-072 minus positioning link, to remove excess lateral movement. Shimming should be between the rear rack slide sideframe and the 94-072 minus positioning link. Adjust 94-068 accumulator engaging arm per C.S.B. P2-502 page IV-E-20.

General Service Memo

THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

MODEL: 211PC192
SUBJECT: Updating
DATE: 10-27-67

Note: This memo is being distributed thru Regional Offices only at this time in conjunction with the introduction of the PC-1421 Inspection Standards Program.

Numerical List of Updating Parts

(2) 6 screw
(2) 70 washer
(2) L-282 spring
(2) L-3250 washer
(2) L-9815 spring
50 washer
(2) 51 washer
880a spring
(2) 1256 nut
1584 spring
2380x2 spring
2583 spring
2749 spacer
59826a spring
60058 washer
(4) 60913 retainer
(2) 60914 retainer
65574 screw
69804xl spring
91356a rod
(12) 91800xl spring
(12) 91952xl pawl
(2) 92384xla cam
94085x2 slide *
94126 fiber washer
94127 friction washer
94367xl bushing
94805 spring
95001a shaft
95950c arm
(2) 95952b arm
96073xlb arm
96119 bracket
96419 pin
96420 pin
96957 pulley
97106c pointer
97150 clamp
97152 washer
97421 gear
98053b bar
98066x2 lever
98136 spring anchor
99072xl bail
99073xl bail
99114xl bracket
99175xlb lever
(9) 99800b spring
(4) 99351xl bushing
910362a roller
911487 F.S. stud
(4) 912067a bracket
(2) 912803 spring
913803a spring
913952xlb line finder
916007a shaft
916059a finger
916087d bail
917091 retainer
918052b shield
91-016c shaft
92-2000xl selector
94-061xl plate
94-113xl slide
94-4001 accumulators
96-075xl arm
(2) 97-074c link
97-149 arm
97-915f cord
97-916e cord
97-920a cord
99-004xle shaft
99-014d shaft
99-128h bail
99-227x2 shaft
99-264 bracket
910-069xlc pawl
911-051xl lever *
911-058x3a lever
913-069xlc bail
913-071b link
915-077b latch

* Trial on first 200 sets may be discontinued if not feasible.

REMOVE BASE PLATE

Transfer Mechanism
59826a spring
94805 spring
94-113xl #3 operating slide

Accumulator Friction Mech.
50 washer
880a spring
(2) L-3250 washer
60913 retainer
94085x2 link *
94126 fiber washer
94127 cupped washer
94367xl bushing
94-060xl plate
94-4001 accumulator

Main Cam Shaft
2583 spring
60913 retainer
99175xla program bell crank
911487 F.S. limit stud
917091 retainer blade
911-051xl cam follower *

Program Unit
2749 spacer
95001a shaft
(2) 95950c arm
95952b arm
99-004xle program cam shaft
99-014d program cam shaft
99-128h program bail
99-227x2 dec. shaft assembly

Base Plate Bails
99072xl bail
99073xl bail
99114xl bracket
(4) 99351xl bushing
99-264 bracket

INSTALL BASE PLATE

Right Side Mech.
98066x2 lever
911-058x3a lever
(2) 51 washer
98136 spring anchor
(2) 60913 retainer
69804xl spring
97916e dec. cord
97-920 dec. cord

* Trial on first 200 sets

Set-Up Carriage Mech.
91356a shaft
(12) 91800xl spring
(12) 91952xl detent
91-016a shaft

Decimal Unit
910362a guide roller
(2) 97-074c dec. lock
97421 gear

Printing Unit
98053b restoring bar
(2) L-282 pressure roller spring
1584 paper release lever spring
913803a spring
913952xlb line finder

Calculator Section
92-2000xl selector
(2) 92384xla register cam

Hold-Up Mech.
96119 bracket
96419 pin
96420 pin
60058 washer
(2) 60913 retainer
(2) 60914 retainer
(2) #6 screw
(2) #70 washer
(2) 1256 nut
96073xlb bell crank

Carriage Return
97-149 arm
97-915f cord
97150 clamp
65574 screw
913-069xlc bail
96-075xl arm
96957 pulley
97152 washer
2380x2 spring
918052d guard

Miscellaneous
916007a shaft
913-071b bail
916-059 div. count finger
916087d zero transfer bail
910-069xlc switch release pawl
915-077b latch
912-067a spring anchor
97106c dec. pointer
(2) L-9815 spring
(2) 912803 spring

In addition to installing the updating parts, the machine should be checked for the following updating corrections:

1. Peened transfer keystem - This was originally covered on FLASH memo of 5-19-67 which is reprinted below. See "Note" at bottom of page.

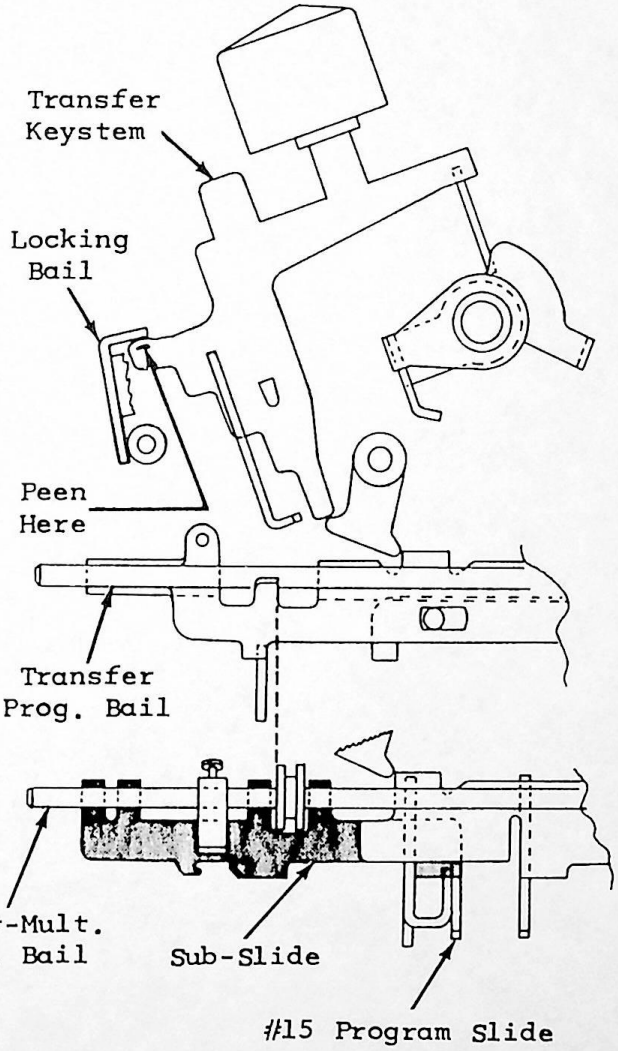
2. Forming of #20 program slide - This was originally covered on FLASH memo of 5-26-67. Pertinent data is reprinted on the following page.

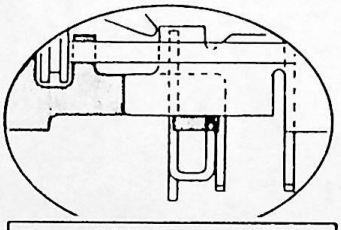
MODEL: 211PC192
SUBJECT: Failure to Program Fully in Transfer-Multiplication Operation
DATE: 5-19-67

Condition - Machine jammed, motor running idle, selector in 1st position. Transfer program bail not fully restored.

Cause - On a quick stroke operation, the transfer keystem can have excessive afterlatch with the keyboard locking bail, allowing the transfer program bail to restore enough so that the sub-slide on the enter-mult. program bail can fail to program the #15 program slide.

Correction - Peen locking lug on the transfer keystem to reduce the amount of afterlatch clearance between the keyboard locking bail and the transfer keystem.



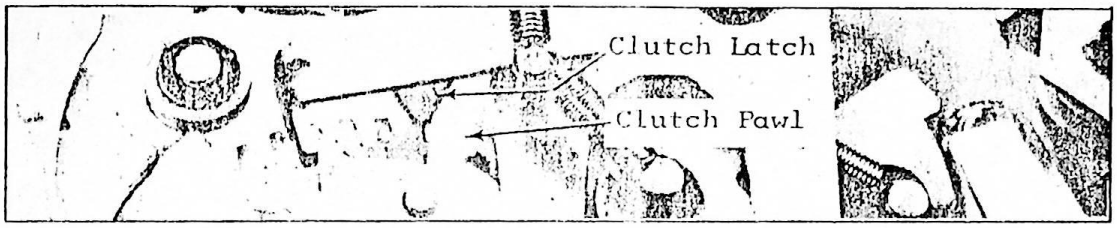


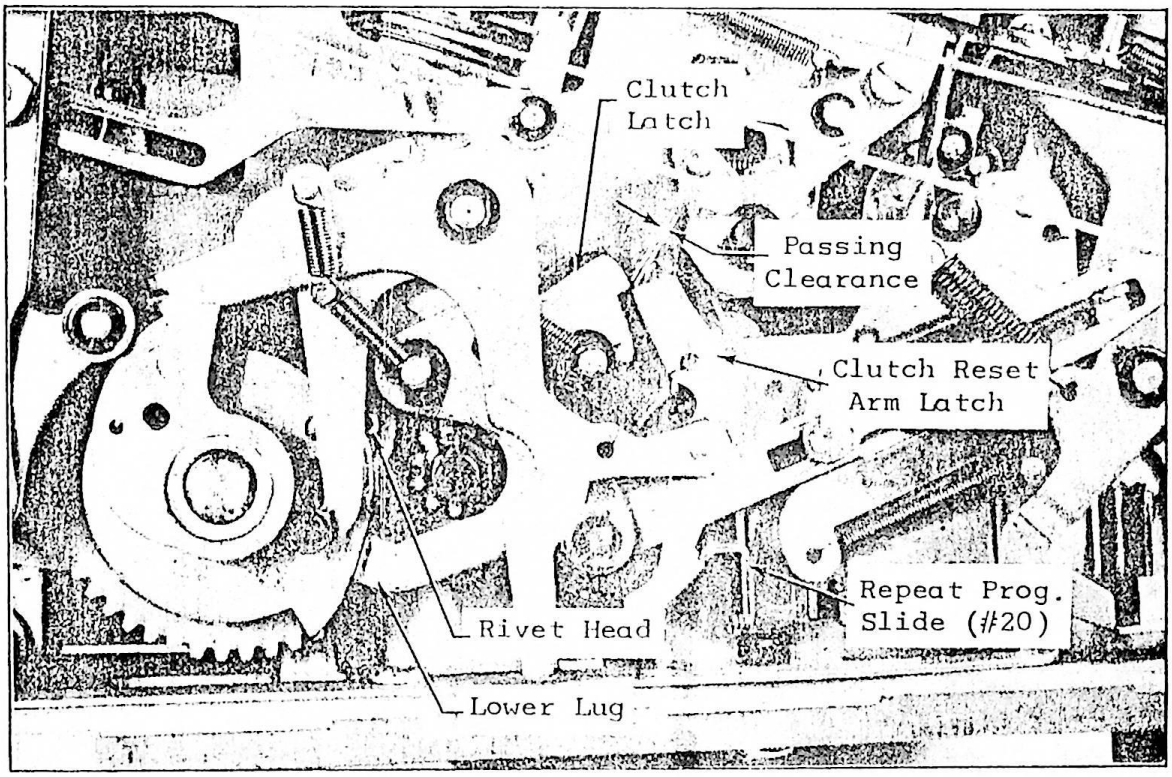
Insufficient Hold On #15 Prog. Slide

Note - Machines with Blue "LL" stamped on left keyboard top plate have been corrected for this condition. Design change is in process and will be released when available.

The following conditions can cause such a momentary interruption in the main shaft cycle:

a. Clutch reset arm latch "nipping" restoring step of clutch latch....This can rock the clutch latch down to where it "nips" the clutch pawl....To correct, form the left end of repeat program slide (#20) rearward enough to provide passing clearance of clutch reset arm latch at step of clutch latch.

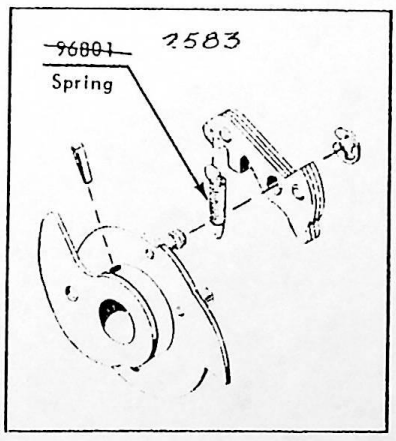




b. Lower lug of clutch reset arm "nipping" head of rivet in clutch pawl.... To correct, form arm outward. Note: A change in design which is currently being processed will eliminate the "button-head" of this rivet.

c. Over-stressed set-up carriage return cable adjustment....To correct, re-adjust.

d. Weak main shaft clutch pawl spring....To correct, replace spring.



General Service Memo

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5-380
Boulder, Colo.

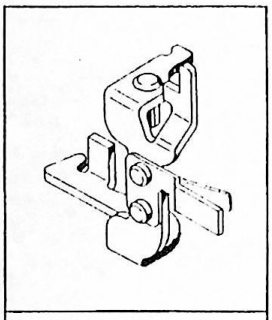
MODEL: 211PC192, 211PC193

SUBJECT: 99-104c, Non-Repeat Bail

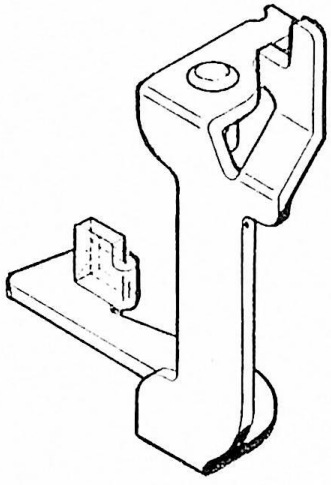
DATE: 11-2-67

The 99-104c non-repeat bail has been redesigned, eliminating its flat latch spring. This revised bail is interchangeable with the previous style bail.

The offset lug on the rear extension of the bail now contains a step. This step, when in its lowered position, engages with lower corner of the number #7, carriage return program slide. The non-repeat bail, therefore, is held latched down during the entire repeat or squaring function by the #7 carriage return program slide. This eliminates the necessity of the latch spring to hold the bail down.



99-104b
Previous Style



99-104c
Revised
(Enlarged View)

NOTE: Machines presently being manufactured contain the improved non-repeat bail; however, these machines also have a sharp corner at the lower left end of the #7 program slide to insure full engagement of the non-repeat bail. When installing the revised non-repeat bail in field machines, it should be checked for full engagement with the #7 program slide. If an unsafe latching condition is evident, the left end of the #7 program slide should be stoned to provide a sharp corner

General Service Memo

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5-380
Boulder, Colo.

SUBJECT: Plastic Cases

DATE: 12-21-67

Unpainted, plastic machine cases such as the 011K, 150, 570, 580 and late 211PC192, etc., are NOT RETURNABLE FOR CREDIT.

It is recommended that the clean-up procedure outlined in the FLASH dated 10-5-67 be followed to remove minor scratches and discolorations.

It is also recommended that cases which are slightly scratched and not returnable be placed on new machines and used for trials and loans until the machine is prepared for sale.

General Service Memo

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5-380
Boulder, Colo.

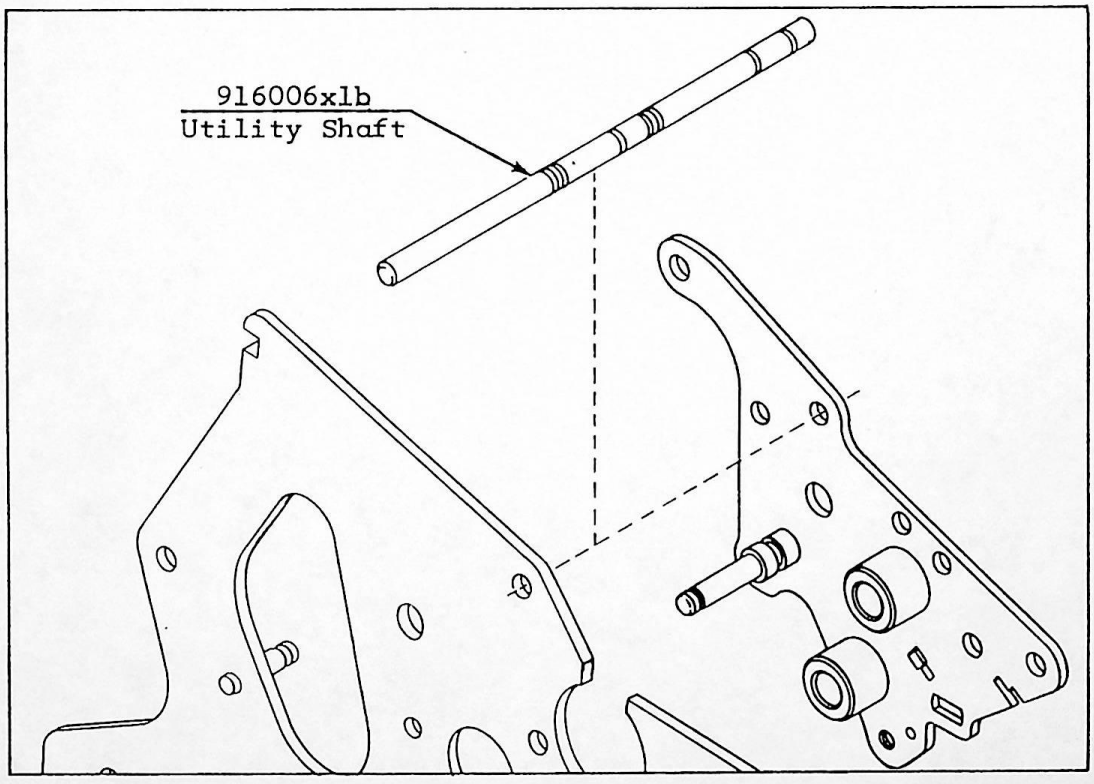
MODEL: PC-1421 & 580
SUBJECT: Improved "Utility" Shaft (916006xlb)
DATE: 3-6-68

Several functional difficulties, which occur during multiplication and division operation, have been traced to a "bowing" of the utility shaft.

The possibility of this shaft "bowing" has been eliminated by making it of a special steel which, for all practical purposes, cannot be bent.

The improved shaft is being installed in all current production machines and can be identified in such machines by a marking of blue dye on its left end.

The improved shaft (916006xlb) is also available on requisition and should be installed in any field machine in which a "bowed" utility shaft is encountered.



General Service Memo

THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

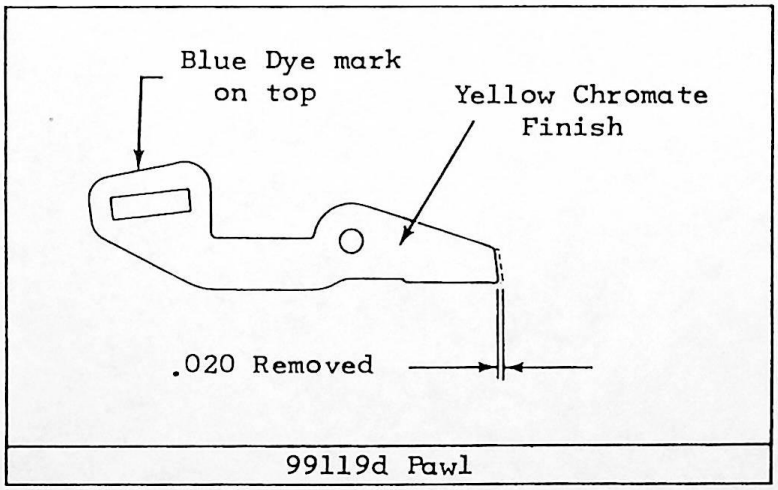
MODEL: 580
SUBJECT: Memory Clearout (Improved Upper Mult. Program Feed Pawl)
DATE: 3-7-68

Condition - Memory clearout rack losing time with detent gear on clearout shaft, causing memory clearout failure.

Cause - The upper mult. program feed pawl over-driving the multiplication program cam shaft into the third detent position.

The over-driven multiplication program cam shaft permits the #21 program slide to partially restore. This causes the memory clearout rack to partially withdraw from the detent gear. As the clearout rack moves forward, the detent pawl is allowed to enter into the notch of the detent gear hub. This engagement of the detent pawl causes the hub of the detent gear to lock against the detent pawl. This results in the loss of timing between the detent gear and clearout rack.

Correction - Install revised (99119d) upper mult. program feed pawl. This pawl has been redesigned to reduce multiplication program drive by .020. The revised pawl is yellow chromated for identification. The top edge, above the slot, has also been marked with blue dye to permit identification in finished machines simply by removing the Keyboard cover plate. Installation in production machines began with serial no. B-081374.



99119d Pawl

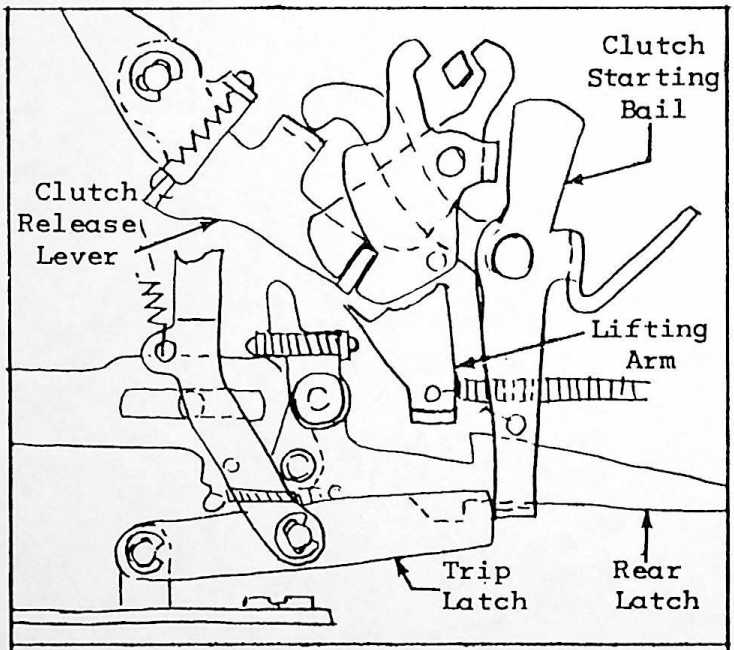
General Service Memo

THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

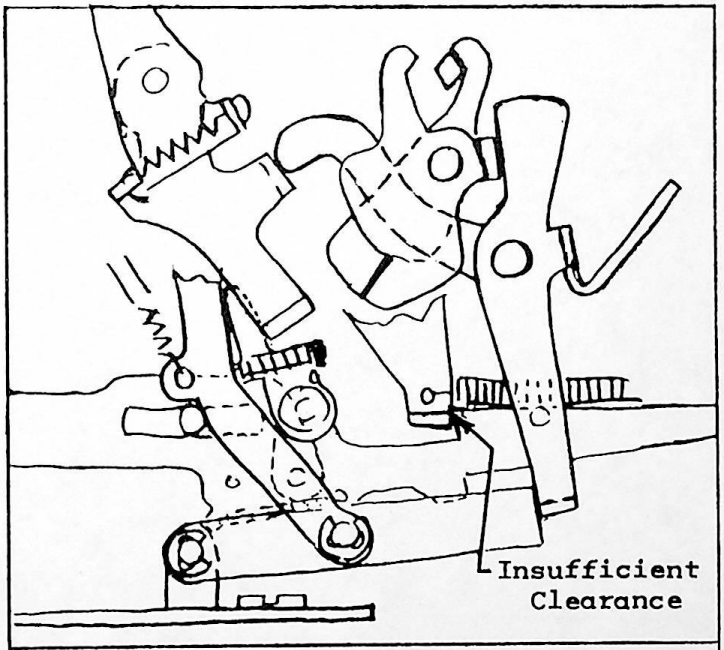
MODEL: 580
SUBJECT: False Entry Into Memory Gears During Product and Quotient Totals
DATE: 3-8-68

Condition - Engagement of memory gears with racks during an acc. or neg. mult. product cycle or div. quotient cycle.

Cause - Insufficient clearance between memory lifting shaft arm and rear latch of #3 operating slide. Note: During both multiplication and division operation, trip latch operated by #13 program slide pivots clutch starting bail which rocks clutch release lever out of engagement with scissors latches and raises rear latch on #3 operating slide. If insufficient clearance exists, this rear latch can "hang up" on lug of memory lifting shaft arm when trip latch subsequently releases clutch starting bail. On the product or quotient cycle which then follows, forward movement of #3 operating slide would engage memory gears with racks and cause product or quotient to be entered in them. Since memory clearout was not programmed, such an amount would be added to the amount already in memory...and if the sum in any column exceeds the memory gear capacity, the racks in that column would jam on return half of cycle.

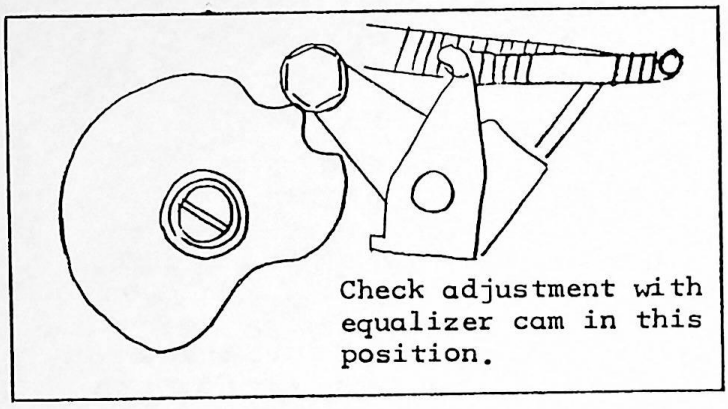


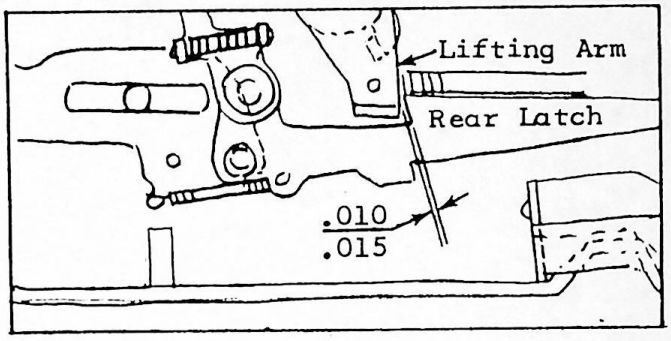
Normal Position



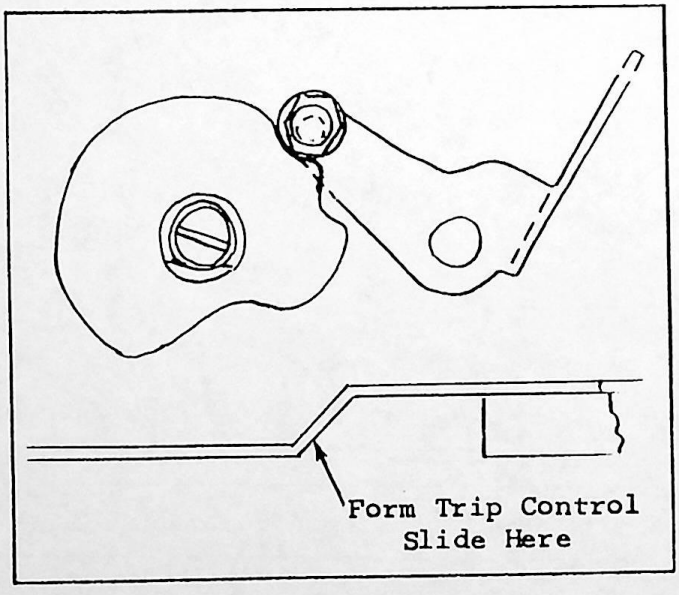
Active Position (Insufficient Clearance)

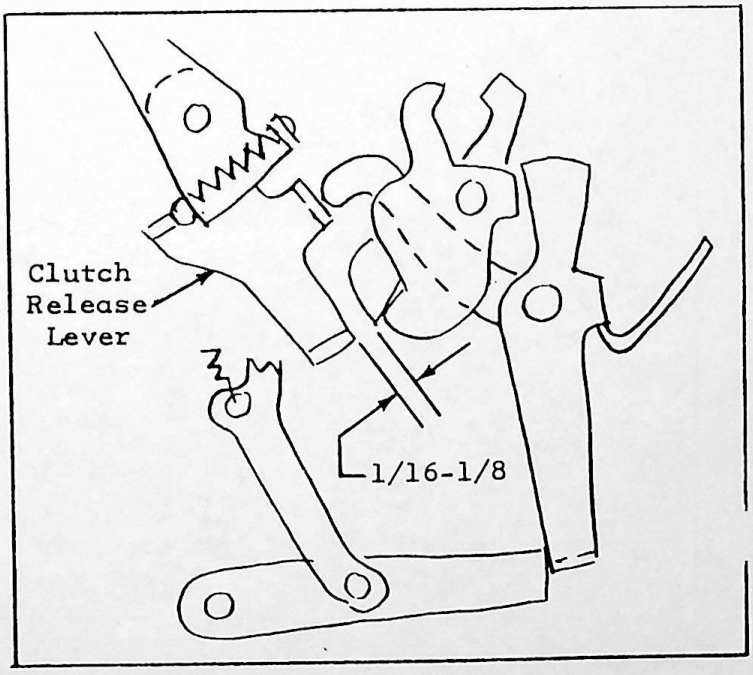
Correction - Adjust memory shaft lifting arm for .010-.015 clearance with rear latch of #3 operating slide. IMPORTANT: When making or checking this adjustment, depress clear key and cycle machine until equalizer cam follower roller is at high point between the "home" and "hold-up" position notches of equalizer cam. (This is done to insure that the drive cam for the operating slide is fully restored.)





Also check adjustment of shift and cycle clutch trip control slide (operated by #13 program slide) as follows: On transfer X, equals and div. operation, the shift and cycle clutch trip control slide should move rearward far enough to remove the clutch release lever from the scissors with between 1/16 to 1/8 inch overthrow. Adjust by forming slide at the offset beneath the equalizer cam. Balance the three positions for the best overall condition.





General Service Memo

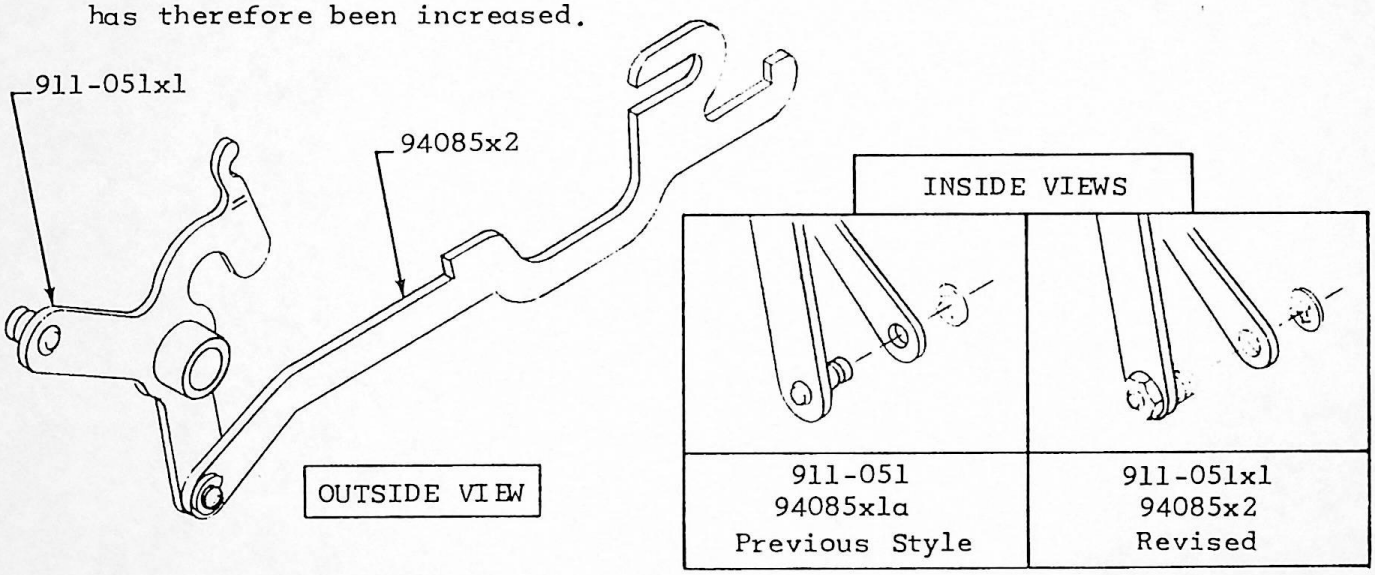
THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

5-330
[illegible], Colo.

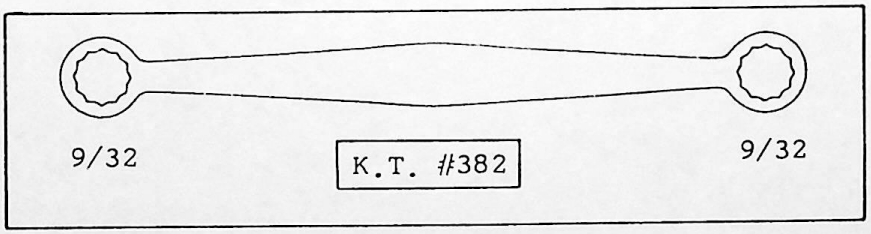
MODEL: PC 1421 & 580
SUBJECT: K.T. #382 For Plus Accumulator Positioning Adjustment
DATE: 3-25-68

The plus/minus cam follower and plus accumulator positioning link have been revised to provide an eccentric adjustment for the plus accumulator positioning function. This will eliminate the necessity of changing cam follower rollers to obtain the plus adjustment as was previously required.

The former positioning link pivot stud in the cam follower has been replaced by an adjustable eccentric stud which is slightly larger in diameter. The size of the pivot hole in the positioning link has therefore been increased.



Because of the unusual dimension (9/32) of the hex head on the eccentric stud, and also because of its location, a special wrench has been made available for making the adjustment. This wrench (K.T. #382) has a 9/32 box opening at both ends.



The list price of K.T. #382 is $1.60.

General Service Memo

THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

5-380
Boulder, Colo.

MODEL: All With Bristol Built Motors
SUBJECT: "Oilite" Bearings - Elimination of Wicks
DATE: 5-24-68

New permanently lubricated "Oilite" bearings are now being used in Bristol built motors. These bearings do not require any further lubrication in the field. Oil wicks are omitted from such motors since they are no longer necessary.

General Service Memo

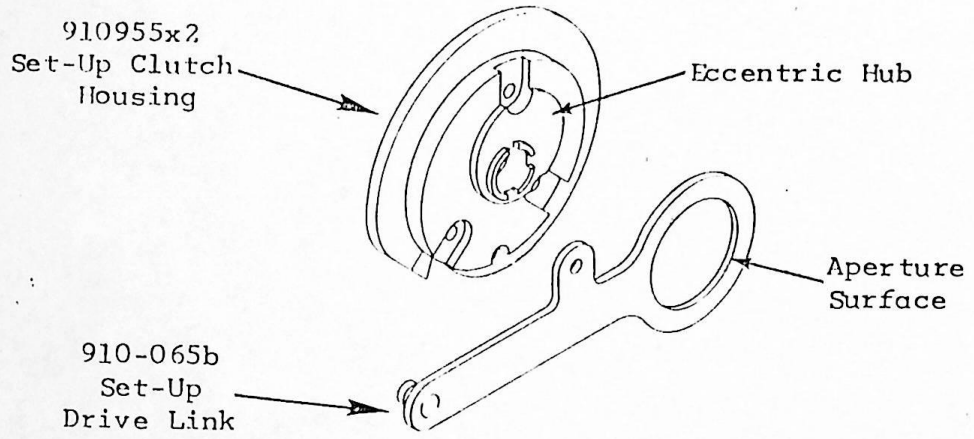
THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

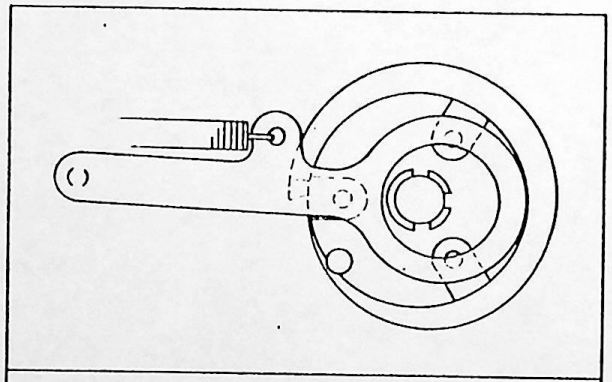
MODEL: 580
SUBJECT: Set-Up Failure
DATE: 6-25-68

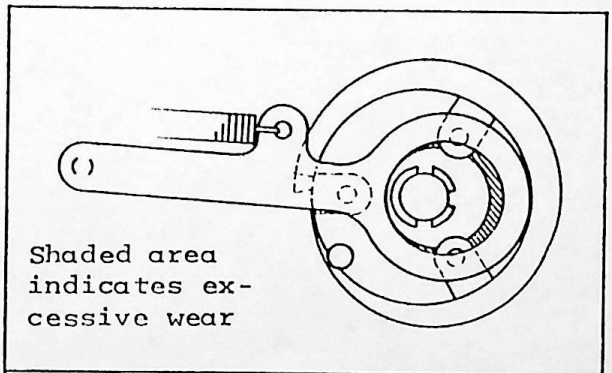
5-046
Mr. J. F. Woods
Denver, Colo.

Condition - Undersetting in set-up carriage...such as setting up "8" when the "9" key is depressed.
Note: While this condition would normally lead one to suspect an improperly adjusted escapement cam follower, machines, especially those in serial no. range B-081300 to B-084519, should be inspected as outlined on the back of this page before any re-adjustment of the cam follower is attempted.

Cause - Defective set-up drive link...causing excessive wear on set-up clutch eccentric hub. Surface of aperture in drive link, which rides on moulded eccentric hub of clutch housing, may be rough or excessively sharp.

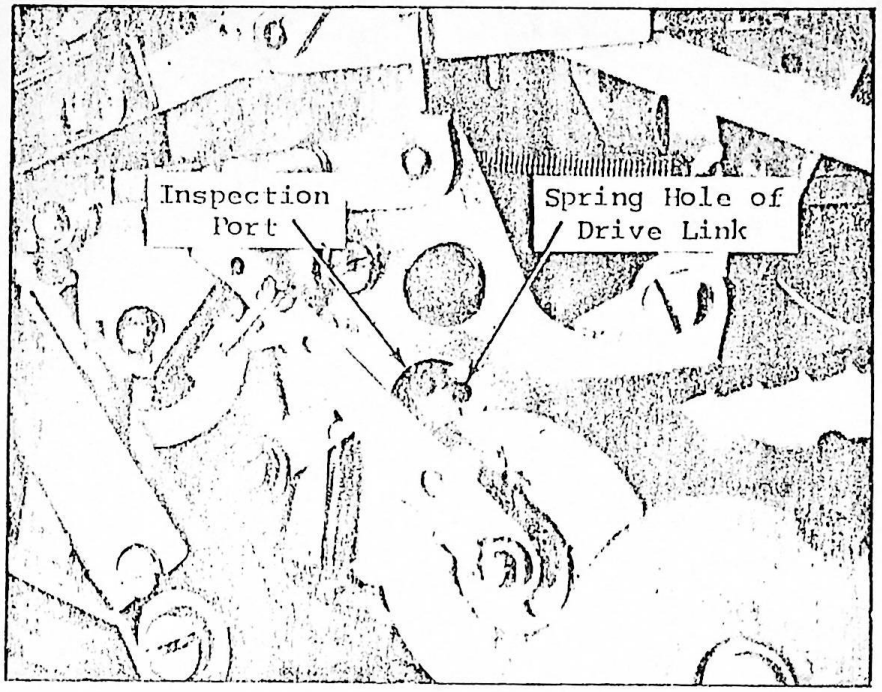



CORRECT



INCORRECT

Inspection - With machine neutralized, insert spring hook thru inspection port in right side frame and into spring hole of drive link. Try to force drive link in all directions by moving spring hook up, down, forward and rearward. There should be no more than .005" play in any direction.



Correction - If more than .005" play is detected, replace both drive link and clutch housing.

Note: When installing new parts, lubricate clutch drive gear with "Estan" grease (Accessory 'G') and apply "Uniflo" oil to eccentric hub and drive link.

This condition has been corrected at the factory in all machines subsequent to serial no. B-084519. It has also been corrected in a number of machines prior to that serial no. Factory corrected machines have been identified by painting the spring lug of the drive link with a blue dye.

Replacement links (part #910-065b) and housings (part #910955x2) are available on even exchange or credit basis. Be sure to disassemble the metal parts from set-up clutch and return only the moulded housing.

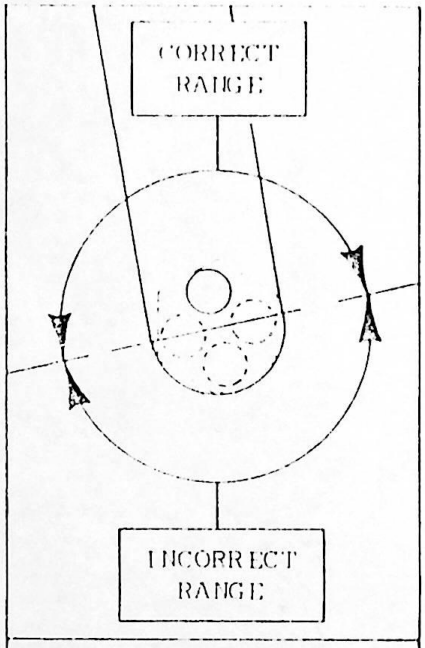
CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

MODEL: PC-1421, 580
SUBJECT: Premature Disengagement of Set-Up Carriage
DATE: 7-22-68

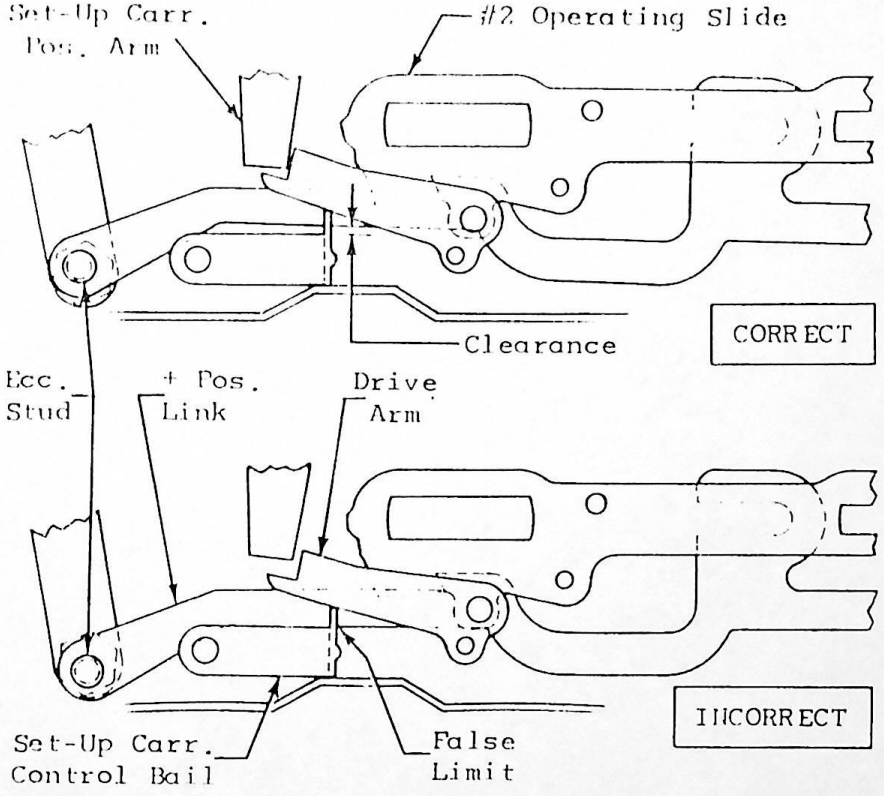
5-046
Mr. J. F. Woods
Denver, Colo.

Condition - On any machine operation in which rack slide movement is controlled by set-up carriage, set-up carriage may disengage from rack slides, permitting them to move rearward and print erroneous nines.

Cause - Eccentric adjusting stud for plus positioning link at bottom of its arc. In this position bottom edge of plus positioning link is lowered. This causes set-up carriage control bail to falsely limit on bottom edge of plus positioning link, preventing drive arm on #2 operating slide from getting a safe hold on offset of set-up carriage positioning arm.



Enlarged View of Eccentric Adj. Stud



Correction - Adjust plus positioning link eccentric so that stud is up in top half of its arc. Then adjust forward or rearward until proper plus accumulator positioning is achieved.

Note: With eccentric properly positioned, bottom edge of plus positioning link will be even with, or slightly higher than lower edge of minus positioning link.

SOUTHWESTERN REGION

BRINGS TIMELY IMPORTANT SERVICE DEPARTMENT NEWS

AUGUST 21, 1968

TO: ALL BRANCH OFFICES AND
SUB OFFICES

FROM: ALLEN DISHAROON
REGIONAL TECHNICAL MANAGER

SUBJECT: M-580 TROUBLE

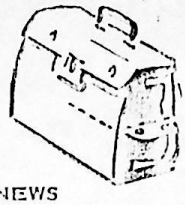
TROUBLE: Jamming during memory entry in 1/2 cent equals multiplication operation

The trouble is in the program section. The detent spring for the 1/2 cent program cam shaft is too weak. When the cam shaft is turned to its 5th position, the detent spring, not being strong enough allows the program shaft to over-program slightly. Therefore, the memory entry control slide is pulled forward to raise the control bail to engage the memory clear rack with the gear on the memory clear shaft, then as the cam shaft was over detented, it allows the memory control slide to move slightly to the rear. This lets the memory clear rack move up almost out of mesh with memory clear gear and the detent to move up and keep the clear out shaft from turning as the clear rack is pulled forward. So the memory gears are not cleared and as the rack moves forward it tears up the clear gear. So now, as you enter new figures into the memory gears on the last half cycle you may jam the machine or the rack slides may tear up the memory gears as they may be limited from turning by the internal zero stop bar, or the racks may separate.

By putting on a stronger detent spring on the 1/2 cent multiplication cam shaft the trouble can be corrected.

THANKS TO JEFF KENER OF SALT LAKE CITY

SOUTHWESTERN REGION



BRINGS TIMELY IMPORTANT SERVICE DEPARTMENT NEWS

AUGUST 21, 1968

TO: ALL BRANCH OFFICES AND SUB OFFICES

FROM: ALLEN DISHAROON

SUBJECT: SCISSORS INSPECTION ON PC-2 AND 580 MODELS

Check for and adjust the scissors so that: When ending a selector shift ... the shift clutch latch is released (Clutch release lever moves into the scissors) ... no later ... than when the shift clutch dog is 45° from neutral position.

This timing should be checked:

1. As the selector is shifted into home position on a simple selector shift.
2. On a decimal transfer ... when the diamond stud moves down.
3. On a division function when the diamond stud moves down.
4. Any time selector alignment is changed.
5. On a PC-2 with the old Transfer Arm ... as the selector shifts into home position.

Attention to the above should definitely reduce the problem of extra shifts of the selector and give us better adjustment judgement. Apparently, we are often living very close to a failure without realizing it.

As to adjustment, several factors enter and are:

1. Proper adjustment of the locator arm (king's crown) and the .015" maximum play specified in item #49 of the PC-2 inspection procedure. This affects the time the diamond stud moves.
2. Height of the diamond stud affects timing. While the height of the diamond stud is closely determined by the points of the scissors, this can often be touched up.
3. The diamond stud can also be moved forward or rearward a small amount and will affect timing.
4. Selector alignment and scissors bail adjustment.
5. Forming the lower lug of the clutch release lever forward or rearward.

This is a problem of timing and coordination between the diamond stud, scissors bail and the lower lug of the clutch release lever.

#68-17

SOUTHWESTERN REGION

BRINGS TIMELY IMPORTANT SERVICE DEPARTMENT NEWS

AUGUST 21, 1968

TO: ALL BRANCHES AND SUB-OFFICES

FROM: ALLEN DISHAROON

SUBJECT: M-580 PROBLEMS

Memory gears jamming between racks and memory clearout gear.

Manually push control slide #21 to its active position. Check memory clearout rack to roll clearout detent gear slightly (no more than .10) clockwise.

With this roll in the clearout gear the possibility of jamming the memory gears point to point with the numeral rack teeth is greatly reduced.

Allen Disharoon
Technical Manager

AD:Fitc

#68-18

TO: ALL BRANCHES AND SUB-OFFICES

FROM: ALLEN DISHAROON

MONROE

KIT

SOUTHWESTERN REGION

BRINGS TIMELY IMPORTANT SERVICE DEPARTMENT NEWS

August 26, 1968

SUBJECT: BLIND SHIMMING TO ADJUST DRIVE TO THE WEDGE UNIT ON A PC-2

At times when servicemen suspect high speed carry over problems, they will blindly shim the drive gear for the wedge unit to obtain more drive. This is done in hope that the problem will be solved without a full tear-down.

SW R-5 Kit of this same date gives you a method of judging transitional carry without a tear-down.

The following is a method of judging shimming of the drive gear without a full tear-down. This method is not 100% sure, but coupled with the transitional carry check mentioned should come close to 100%.

The main danger of blind shimming is that often the wedge unit is driven too far left and cramps a carry gear against a partition plate or causes carry gear teeth to nip the register intermediate gears.

Enter eleven 8's in the selector.

Enter 5 in the KB and depress the equals key.

Hand crank the machine until the second selector cycle begins and the wedge unit is driven full left (machine's left). Wedges have been detented and the carry gears are also driven to the left.

With a spring hook, try to move the wedge unit farther left. If it will not move left without straining .... the carry gears are limiting on the partition plates and must not be driven further.

If the wedge unit can move farther left .... you <u>may</u> be able to shim for more drive by checking as follows:

By tipping the machine up on its front end and looking through the rear rectangular opening of the bottom frame, movement of the tips of the carry gears can be observed .... just over the hubs of the register intermediate gears. Primary carry can be observed this way in columns 2 through 12. Other columns can be checked by entering 5,000,000,000 on an equals function.

While the wide tooth of the carry gears cannot be observed, the closeness of the carry gear teeth to the intermediate gears can be observed as primary carry takes place.

#68-20

TO: ALL BRANCHES AND SUB-OFFICES

FROM: ALLEN DISHAROON

MONROE

KIT

SOUTHWESTERN REGION

BRINGS TIMELY IMPORTANT SERVICE DEPARTMENT NEWS

August 26, 1968

SUBJECT: PC-2 HIGH SPEED TRANSITIONAL CARRY CHECK .... WITHOUT A TEAR-DOWN

This check is not as accurate as a tear-down check but is good enough to let you judge transitional carry.

Enter an "0" in the selector.

Enter a 6 in the KB and depress the Equals key.

Hand crank the machine until the selector just starts to turn.

Tip the machine up on its front end and look through the bottom frame rear rectangular opening as follows:

Look through the opening at its end closest to the motor .... and find the register intermediate gears.

Over the hubs of the register gears you can see the wide carry over drive gears .... and just over the hubs of the intermediate gears .... you can see about 1/32" of the carry-over gear teeth.

The carry gear teeth will be just to the left (machine's left) of the right end of the register intermediate gear hubs.

Slowly cycle the machine and you can see the tips of the carry gear teeth move towards you.

Now .... angle your view so that you can see the hub of the 19th intermediate register gear.

As you cycle the selector, you will see the wide tooth on the carry gear come toward you .... and then go out of sight behind the hub.

When transitional carry occurs .... you will not be able to see the wide tooth .... but you can see the teeth of the carry gear move left.

When transitional carry occurs .... and the carry gear moves left .... you can judge how close the carry gear teeth come to the teeth of the intermediate gear .... and thus judge the amount of transitional carry you have .... at the 19th column.

The 21st carry gear can also be seen by looking through the bottom frame opening that is between the motor and the rectangular opening.

If transitional carry fails, it may not occur again on the remaining cycles .... and you will have to set up another multiplier.

#68-21

TO: ALL BRANCHES AND SUB-OFFICES

FROM: ALLEN DISHAROON

MONROE

KIT

SOUTHWESTERN REGION

BRINGS TIMELY IMPORTANT SERVICE DEPARTMENT NEWS

SUBJECT: PC-2 AND 580 REGISTER ZONING ADJUSTMENT

August 26, 1968

We have found that many PC-2 servicemen are not aware of a zoning adjustment for the register unit that was added about two years ago.

The limit screw 94744, lock nut and washer is shown on the left upper corner of page J-2 of your PC-2 parts book (CSB #P2-501). This screw acts as a left limit for the register unit.

When a PC-2 is torn down for work in the register unit area the following should be checked:

The register unit should be positioned so that the collar on its right end just touches the side frame of the machine .... but without binding.

The legs of the register unit may have to be formed left or right to allow the above conditions.

The register unit legs must not exert side pressure against the guide studs but should have very little play at the stud shoulders.

The upper guide collar for the register unit must also be zoned to allow the register unit proper left and right position.

The shoulders of the register unit eccentric adjusting nuts should not limit at the register unit guide brackets.

With the register unit properly positioned .... the left limit screw (94744) should be adjusted so that there is bare minimum left and right play in the register unit .... after the lock nut is tight.

NOTE: All of the above can be checked and adjusted without a tear-down.

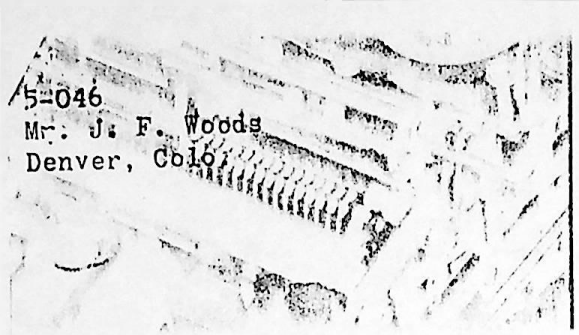
Important: This adjustment properly made will assure maximum transitional carry by keeping the register unit from moving left and decreasing transitional carry.

Caution: Check primary and transitional carry if the register unit left and right zoning is changed.

Suggestion: The above limit screw can be added to older PC-2 models to stabilize register units and high speed carry. A long size 6 screw can be used in place of the listed screw.

Caution: If the left limit screw is adjusted so that it has pressure against the register unit, the register unit may be slow to restore or fail to restore after a register total or register entry function.

#68-19



General Service Memo

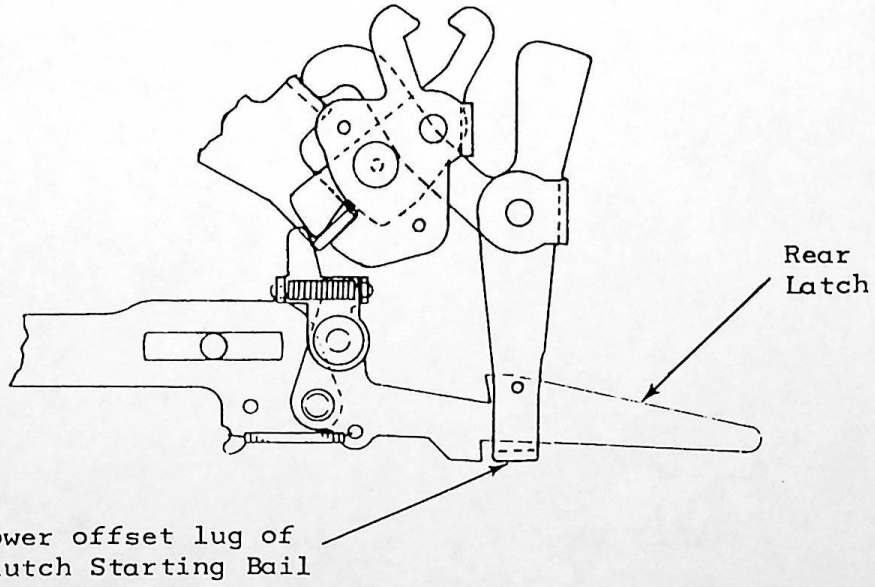
THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

MODEL: PC-1421 (with revised Transfer mechanism) & 580
SUBJECT: Prevention of Selector damage by improved control of Clutch Starting Bail
DATE: 11-15-68

Possible Conditions - Jam, stripping of selector setable teeth and/or breakage of selector clearout gears and/or other selector damage in decimal Transfer X or Memory X or Division (with quotient transfer) operation. Jam and/or miscal. in normal Division or Multiplication operation.

Cause - Selector not in "home" position at beginning of the operation... due to improper lateral position of the clutch starting bail on a previous operation.

The relationship between the lower offset lug of the clutch starting bail and the rear latch on the #3 operating slide is the critical area. With the previous adjustment of this relationship (ref. page P-38, C.S.B. #P2-501) it was possible for the rear latch to cam off a rounded corner of the starting bail lug...and fail to trip on a decimal Transfer X or Memory X operation.... This would leave the selector out of "home" position. If compensating adjustment of the starting bail was made, the rear latch could "nip" the starting bail on other operations when it wasn't supposed to...and this could also result in the selector shifting one place out and staying there.... In either event, one of the "possible conditions" described above could then occur.

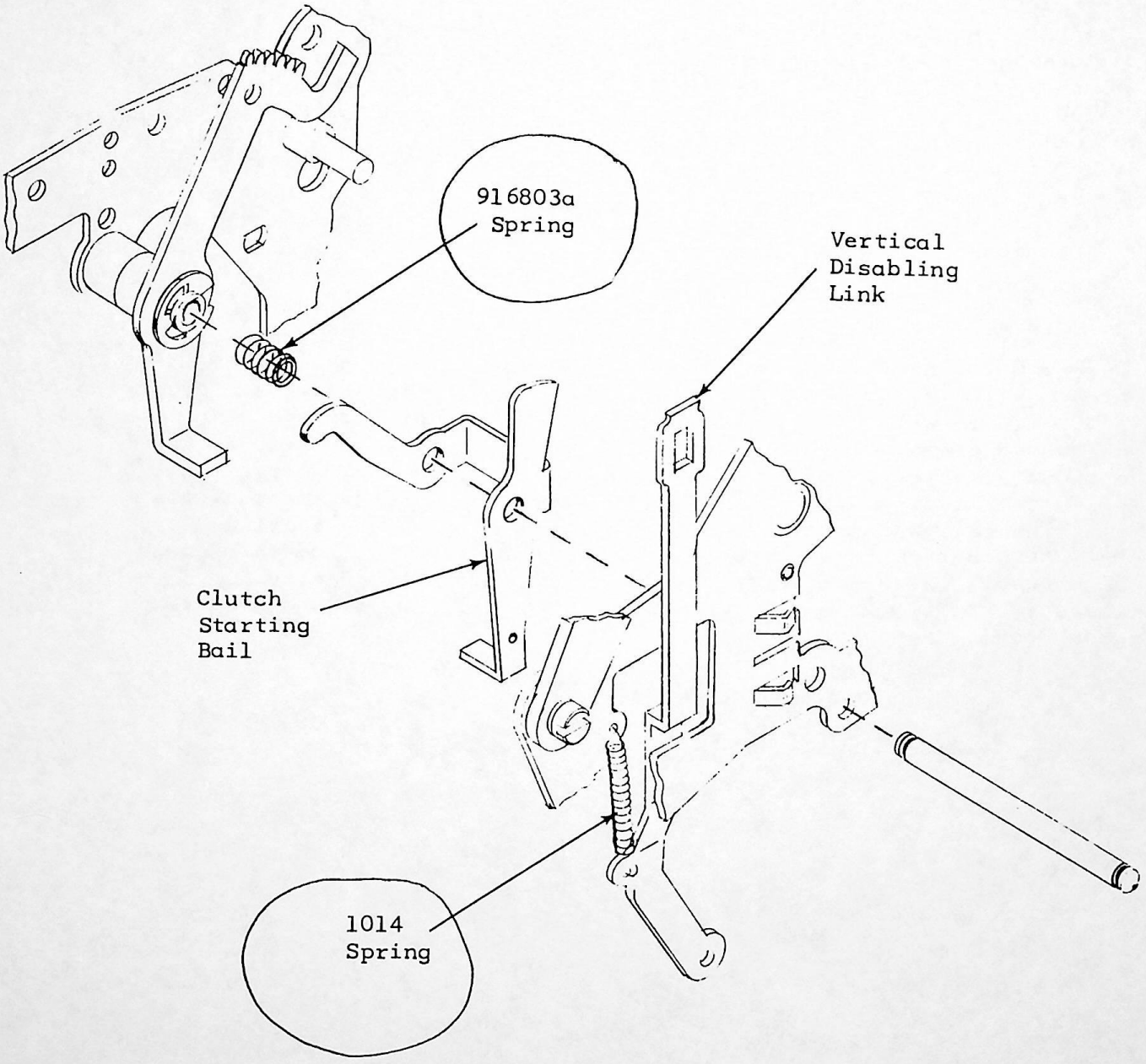


Correction - There are three steps:

1. Install 916803a compression spring behind clutch starting bail as illustrated.

2. Replace the L-383 spring on vertical disabling link with a 1014 spring. (The 1014 spring is lighter.)

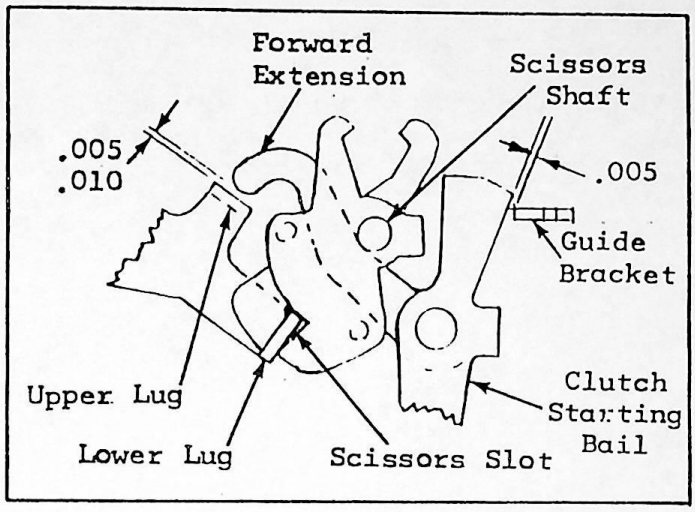
3. Carefully perform the adjustment procedure which starts on the following page.



Installation of 916803a and 1014 Springs

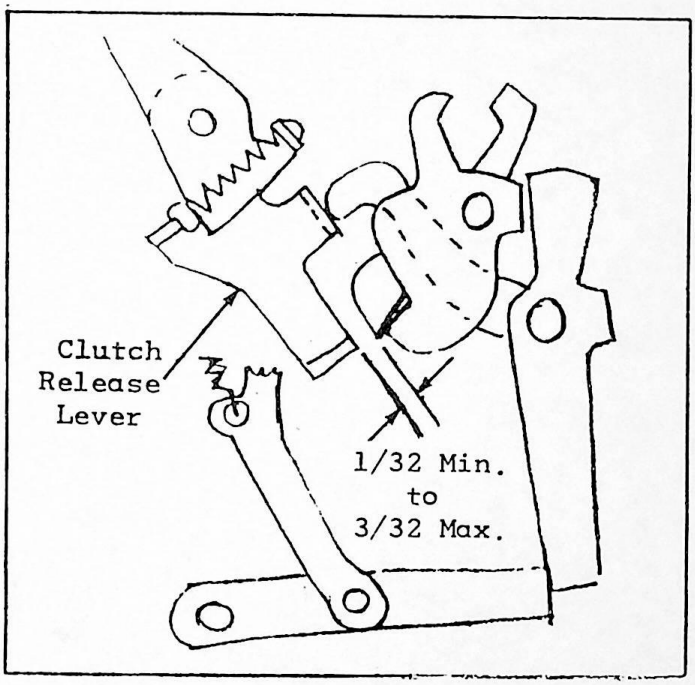
#1. Check Starting Bail

With forward extension of clutch starting bail limited against scissors shaft and lower lug of clutch release lever limited in top of scissors slot, check for .005 to .010 clearance between forward extension of starting bail and upper lug on clutch release lever. There must be a minimum of .005 clearance between the forward edge of the guide bracket of the positioning plate and upper rear edge of the clutch starting bail.

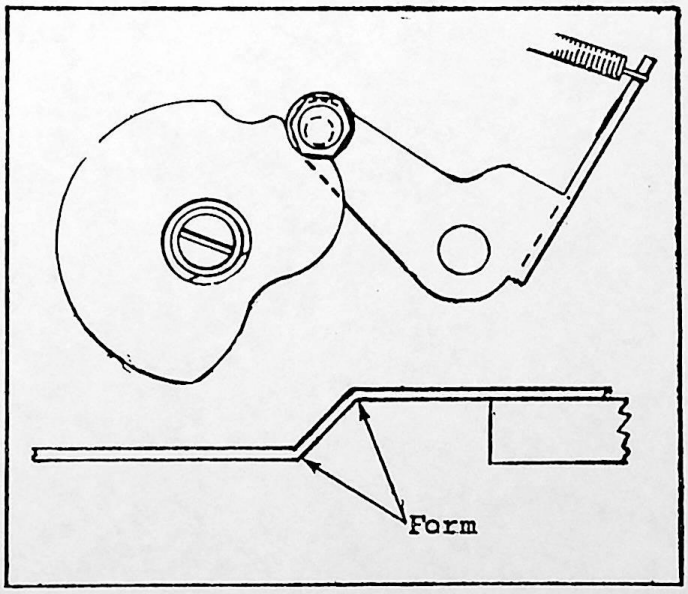


#2. Check Shift and Cycle Clutch Trip Link

On transfer X, equals and div. operation, the shift and cycle clutch trip link should move rearward far enough to move the clutch release lever out of the scissors with from 1/32 to 3/32 inch overthrow. Adjust by forming slide (#13) at the forming beneath the equalizer cam. Balance the three positions for the best overall condition.
Note: If forming is required, check passing clearance between clutch release bail latch and clutch release bail. (Refer to illustration on next page.)



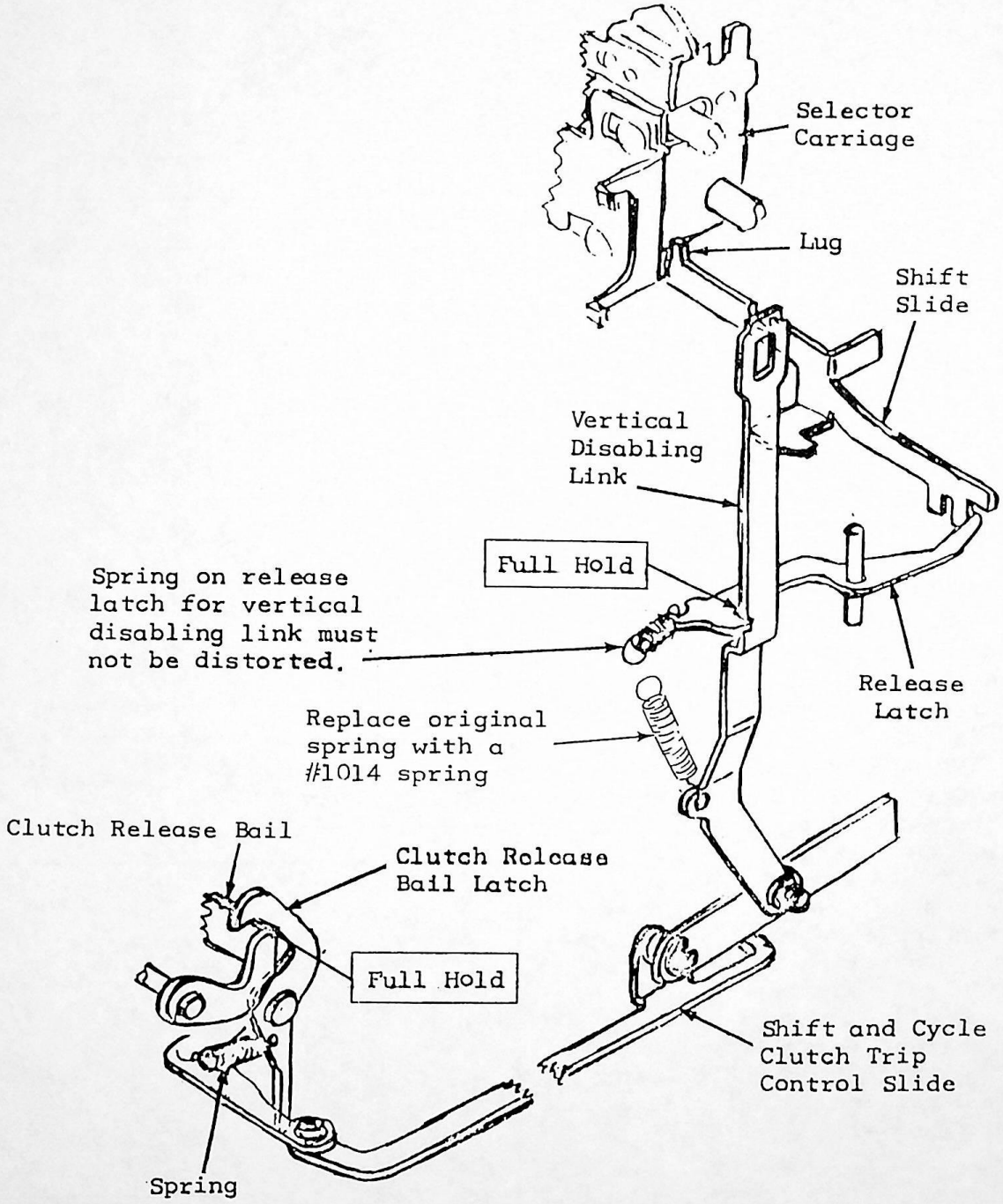
On a return shift of the selector on a transfer/memory X operation, the clutch starting bail (now rocked by the rear latch on #3 operating slide) should move the clutch release lever from 1/32 to 3/32 of an inch from the scissors. If this condition is not present, re-check Item #1.



#3. Check Release Latch for Full Hold with Vertical Disabling Link.

Set decimals at 3-3, depress transfer X.

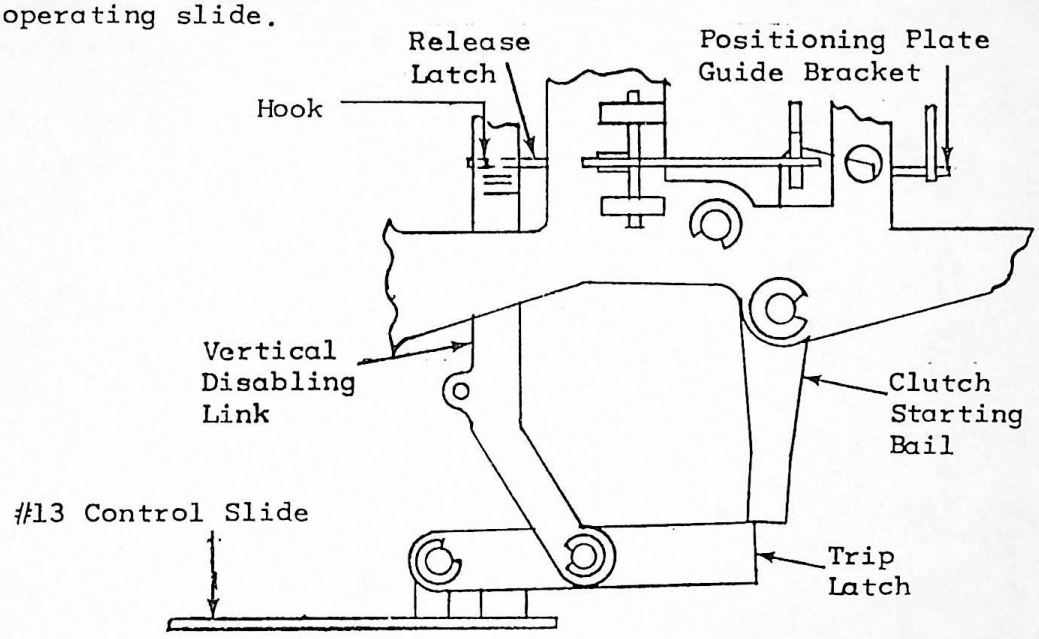
Cycle mach by hand. Check for full hold of clutch release bail latch over clutch release bail and full hold of hook on disabling link on left selector shift. Restore mechanism.



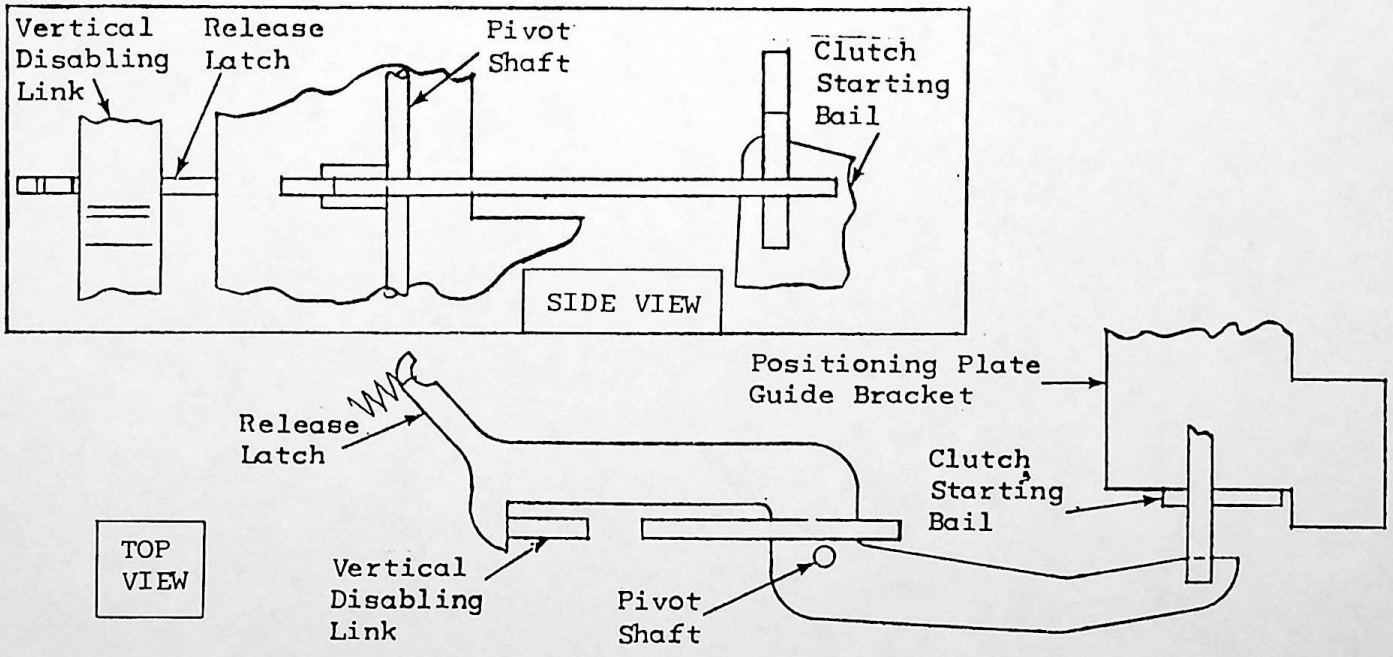
#4. Check Positioning of Clutch Starting Bail from Release Latch

Manually unlatch the shift clutch latch and cycle machine...positioning selector in the second column.

Manually lower the trip latch on the #13 control slide and position the #13 control slide slightly rearward until the rear edge of the trip latch is beneath the offset lug of the clutch starting bail. At this position the hook for the release latch must be behind the vertical disabling link, as illustrated. Release the trip latch and snap #13 control slide rearward...allowing the release latch to fully pivot... positioning the clutch starting bail into alignment with the rear latch of the # 3 operating slide.



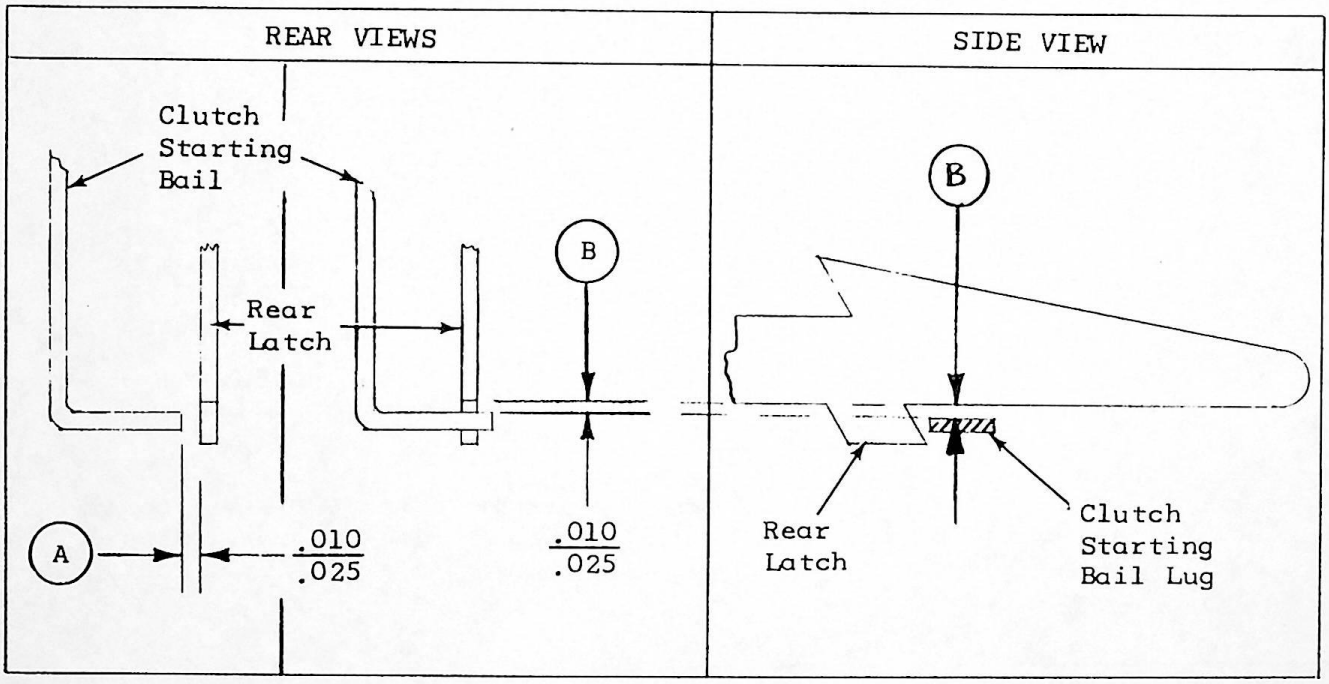
Check that the clutch starting bail has moved to its full left position, against the guide bracket for the positioning plate by positioning a probe against the upper extension of the clutch starting bail and applying leftward pressure.



#5. Clutch Starting Bail Adjustment

Depress clear key and cycle machine until the rear latch of the #3 operating slide moves fully rearward. Remove all outward play from rear latch on #3 operating slide. There must be .010 to .025 clearance (A) between the lower offset of the clutch starting bail and right side of the rear latch on #3 operating slide. Complete cycle.

Set decimal at 2-0 and depress memory/X key. Cycle until selector shifts into the second column and the clutch starting bail moves into alignment with the rear latch on the #3 operating slide. At this time there must be .010 to .025 clearance (B) between upper surface of the clutch starting bail offset and the lower surface of the rear latch on the #3 operating slide.



General Service Memo

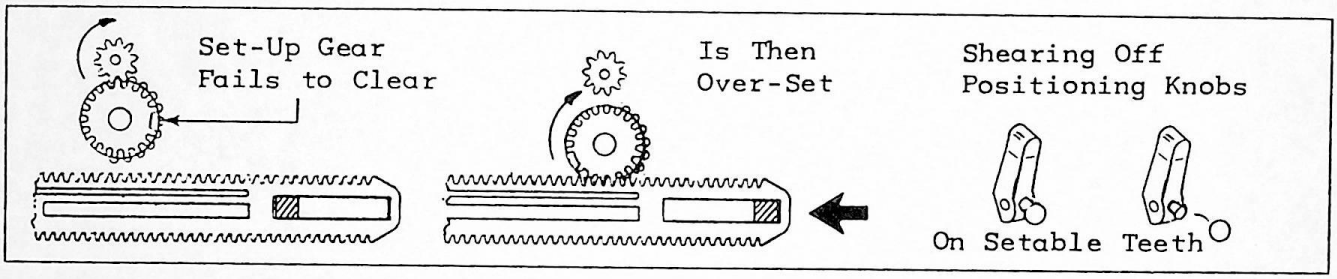
THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

5-046
Mr. J. F. Woods
Denver, Colo.

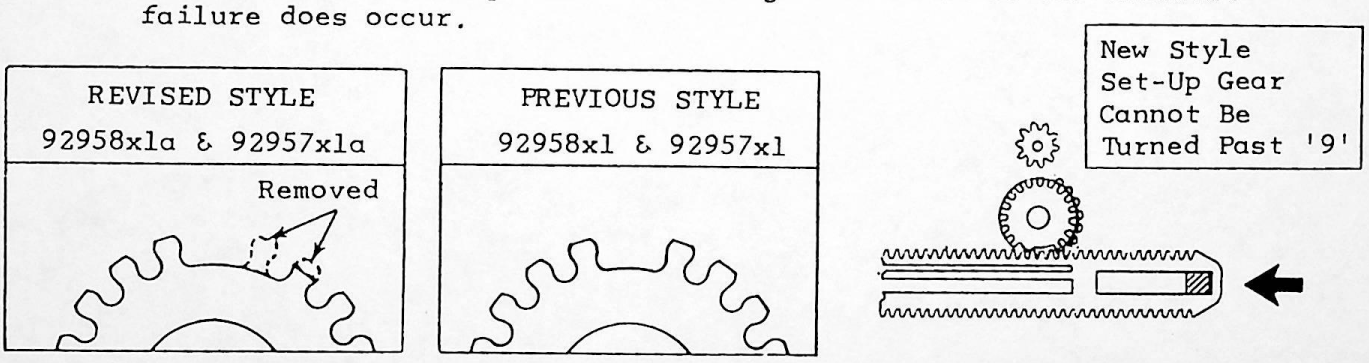
MODEL: PC 1421 & 580
SUBJECT: Selector Improvement
DATE: 11-22-68

Condition - Internal breakage of Selector Setable Teeth

Cause - Failure to fully clearout the selector on the clearout phase of a selector set-up cycle.... Should the combination of the amount remaining in a given column and the amount entered exceed nine, the set-up gear will be over-driven...and the end of its camming slot will shear off the little positioning knobs on the interval ends of the setable teeth.



Correction - Obviously the reason for the clearout failure must be analyzed and corrected.... The purpose of this release, however, is to advise service personnel of an improvement made in the selector which will prevent the damage described if the clearout failure does occur.



One and a half teeth have been removed from each selector set-up gear at the rearward end of the "clearout gap".... Once a rack has turned such a set-up gear to its "nine" position, the absent teeth will prevent further rotation of the gear if the rack continues to move forward.

The revised selector assemblies (92-2000xl) are identified by a stripe of yellow Dykem across the fixed gears. They are currently being installed in all production machines and are available on requisition from Orange for field replacement needs.

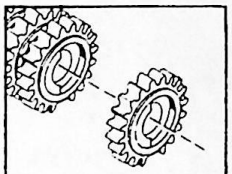
5-380
Mr. R. L. Hoffman
Boulder, Colo.

General Service Memo

THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

MODEL: 580
SUBJECT: Incorrect Memory Read-Out
DATE: 1-10-69

Condition - Intermittent failure to fully read-out the amount from the memory gears during a memory multiplicand or memory dividend operation. This condition will be evident when the incorrect read-out from the memory gears is a lesser amount than the amount actually stored in the gears.


Memory Gears

Cause - The material used in the manufacture of memory gears was changed in June, 1968, to reduce wear on the gears. While the new material has superior wear resisting characteristics, it is slightly more susceptible to heat induced shrinkage. In some instances...when the outside diameter of a memory shaft is on the "high side" of its manufacturing tolerance, and the hole in one of the memory gears is on the "low side" of its tolerance...shrinkage may eventually cause a tight condition between the gear and shaft. In such cases, the rack spring could fail to pull the rack rearward far enough to turn the memory gear to its zero stop...and an incorrect read-out would result.

This condition has since been corrected at the factory...and field occurrence will be confined to some of the machines in the following serial number groupings:

B083100 thru B088967
B720000 thru B720500

Inspection - All model 580 machines in the above serial number groupings should be inspected in the following manner:

1. Manually enter nines in all 21 memory gears.

2. Depress the memory/dividend keys and hand cycle the machine until the racks have moved fully rearward.... Stop cycling before print hammers fire.

3. Manually restore the racks (one at a time) toward the front of the machine and allow them to slowly move rearward. All racks must be moved freely and fully to the rear by the rack spring tension.

Correction - If one or more gears are found to be binding, replace ALL 21 with improved memory gears. Improved gears (part number 94962b) are available on requisition from Orange. They are temporarily being identified by a light gray-green coloring.

NOTE: All field stock of previous memory gears should be returned for credit or even exchange.

General Service Memo

THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

MODEL: 580
SUBJECT: 94964 FS Replacement Gear
DATE: 3-3-69

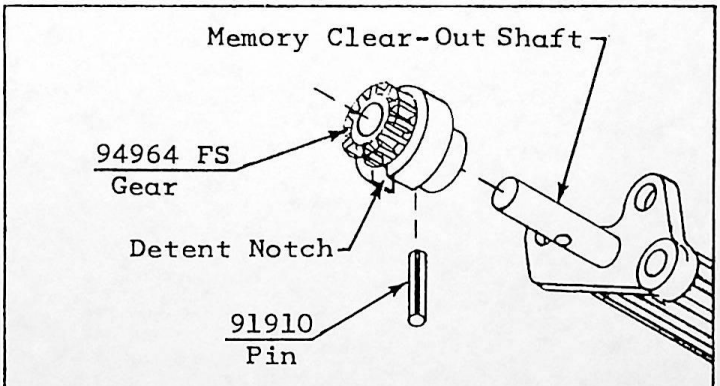
[illegible]16
[illegible]. F. Woods
Denver, Colo.

A special field service pinion gear (94964 FS) has been made available for replacement of worn or broken pinion gears on the 94-026a memory clear-out shafts. Special manufacturing controls of this replacement gear permit interchangeability with the original gear.

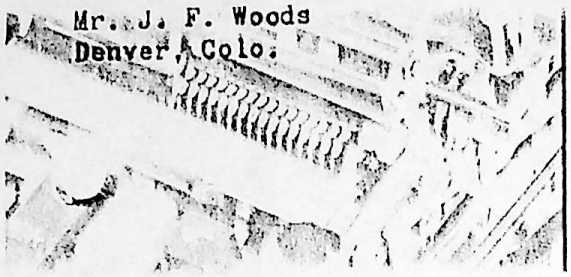
Note: Interchangeability is limited to 94-026a clear-out shaft assemblies that contain a roll pin in the hub of the pinion gear. (Gears containing taper pins are not replaceable. When worn gears with taper pins are encountered, the entire 94-026a shaft should be replaced).

INSTALLATION:

1. Remove motor assembly.
2. Remove mounting screws from the memory clear-out shaft bearing bracket and remove the 94-026a shaft assembly.
3. To assure correct timing relationship of the new pinion gear to the metal clear-out shaft, mark location of pinion gear detent notch onto the clear-out shaft before removing old gear.
4. To prevent distortion, brace the clear-out shaft and remove the roll pin. Remove pinion gear.
5. Install new pinion gear with its detent notch on marked side of shaft.
6. Install a new roll pin (91910).
7. Reassemble mechanism and check adjustment of clear-out drive rack engagement (refer to C.S.B. #P2-502, Page V-J-13).



VIEW FROM BELOW - LEFT



General Service Memo

THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

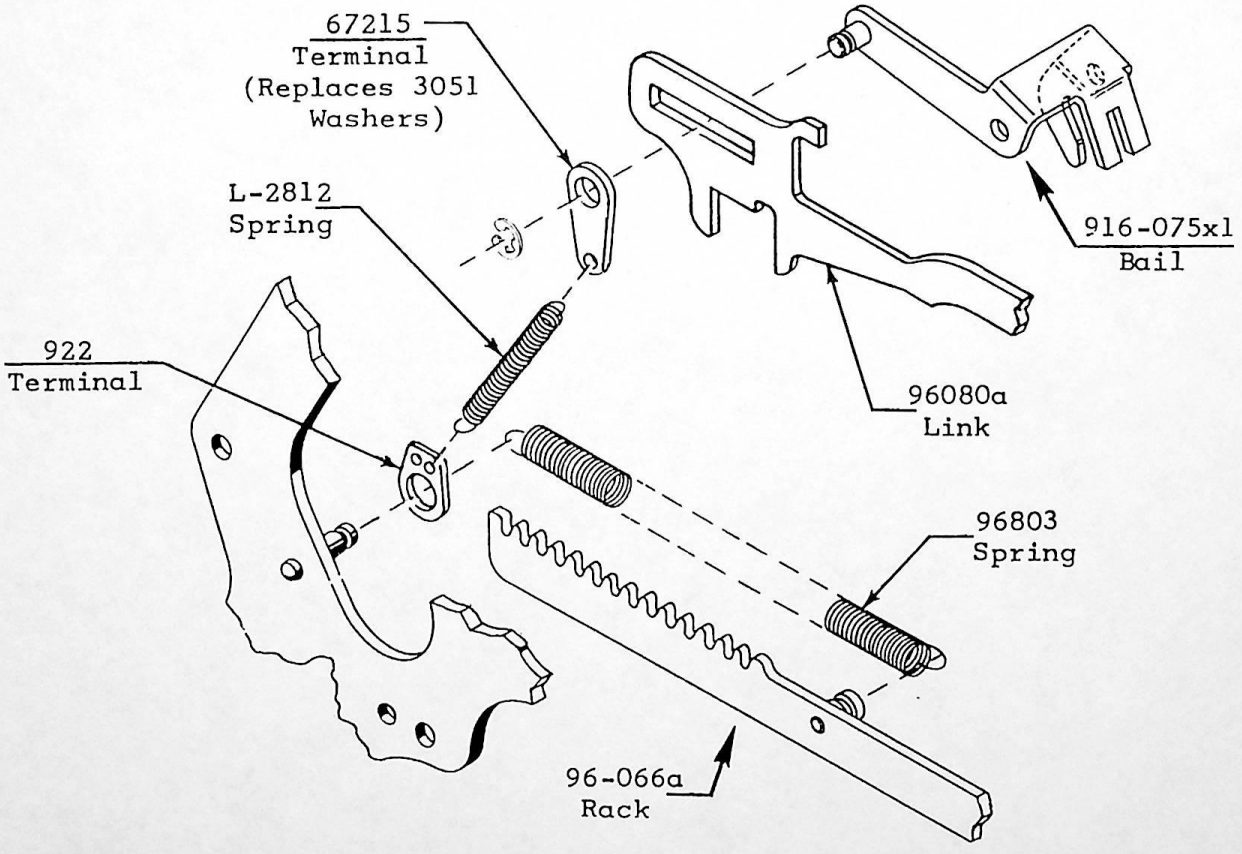
MODEL: 211PC192, 211PC193, 580
SUBJECT: Memory/Transfer Hold-Up Failure
DATE: March 14, 1969

Condition - Failure to activate the 96-079x2 hold-up link during a decimal multiplicand transfer operation.

Cause - Inadequate downward positioning of the 96080a division/transfer link. This results in a marginal engagement with the stud on the 96-051 tab shaft operating arm. During the programming of a decimal transfer operation, if the division/transfer link had not fully positioned onto the stud on the operating arm, the 916-002a tab shaft would not be activated, which would result in a transfer operation that is not programmed for hold-up. Failure to program hold-up during a transfer/memory operation can result in damage to the selector and its related mechanism.

Because of the simplicity of this improvement, it is recommended that all machines being serviced be updated to include this improvement.

Correction - Install the positive positioning spring and terminals as illustrated....



Model: PC-1421 - 580
Subject: Selector Drive Shaft #92000
Date: 6-20-69

Effective immediately 92-2000xl selectors will be shipped from Orange without the drive shaft.

Branches returning selectors to Orange Parts Department should not return the drive shaft with old selectors. Should a drive shaft be needed for replacement, order shaft by its part number (92000).

MODEL: 580
SUBJECT: Sluggish Numeral Keyboard
DATE: 6-24-69

Condition - Sluggish or loss of numeral set-up cycle during a numeral keyboard entry. This condition is most evident when the numeral keyboard is operated in a normal rhythmic manner common to touch operators.

Cause - There are various causes related to the described condition, some of which are not readily accessible. Since accessibility is a factor for correction, the following inspection sequence, which is outlined to direct inspections starting with the most accessible areas, should be followed.

1. The outward spring stud on the 910-051 clutch pawl may be limiting on the 910-068 switch mounting plate when the set-up clutch neutralizes.

2. No end play in the 99-007m clutch operating shaft.

3. Distorted or bowed operating plate on right end of the 99-007m set-up clutch operating shaft.

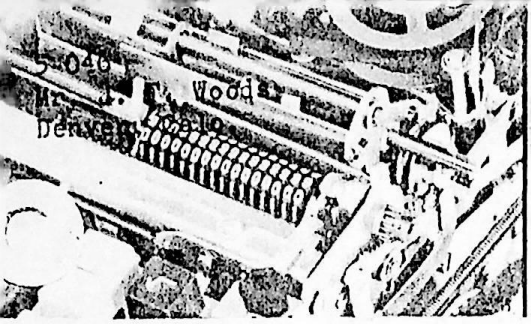
4. Distorted or bowed 910-054x2 clutch operating link.

5. Incorrect form angle on the 910052x1 single cycle latch.

6. Detent roller stud on the 910-050x1b set-up clutch plate not at correct square position to plate.

Correction - Inspection #1 - Replace or lower rear end of the 910-068 switch mounting plate.
Inspection #2 - Free bearings within the program unit for .005 - .010 end play in the 99-007m shaft.
Inspection #3 - Straighten operating plate on the right end of the 99-007 clutch operating shaft to align with the 910-054x2 clutch operating link.
Inspection #4 - Replace or straighten the 910-054x2 operating link.
Inspection #5 - Install new 910052x1 single cycle latch.
Inspection #6 - Install new 910-050x1b set-up clutch plate.

NOTE: Base plate should be removed to install new parts for Inspections 4, 5 and 6.



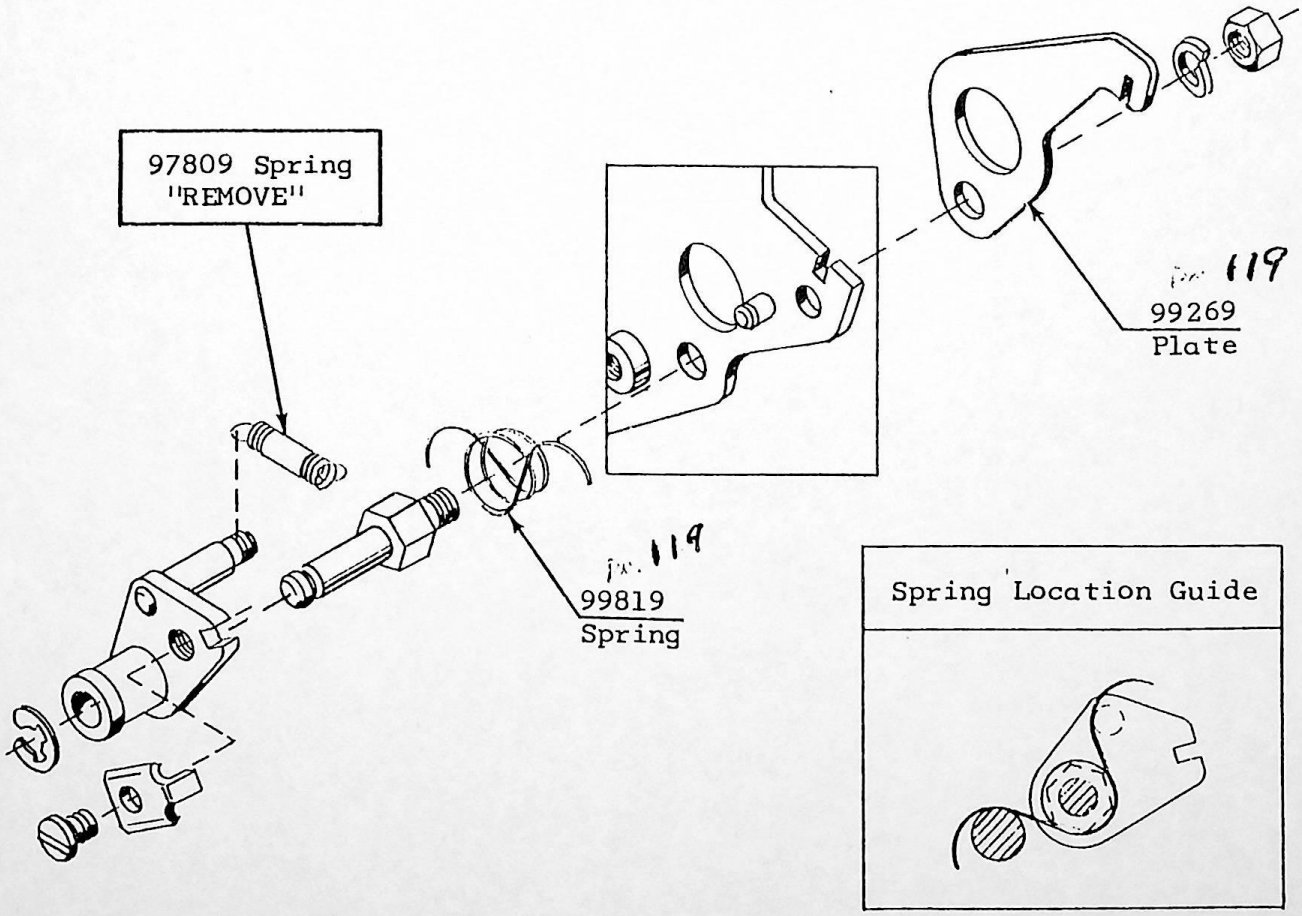
General Service Memo

THE INFORMATION CONTAINED IN THIS NOTIFICATION IS THE CONFIDENTIAL PROPERTY OF MONROE INTERNATIONAL

Model: PC-1421 - 580
Subject: Worn Left Side Frame
Date: 7-18-69

CONDITION: Carriage return drum limit worn.

PROBLEM: Loss of Carriage Return adjustment or unfastening of carriage return drum spring (Part #97809).

CAUSE: During carriage return functions, the carriage return drum stud limits with impact against the forward and rearward surfaces of the frame opening. This impact causes an enlargement of the opening, which subsequently necessitates the refastening of the restoring spring or adjustment of the carriage return mechanism.

CORRECTION: Install the new limit plate (Part #99269) and spring (Part #99819)...See installation illustration below.